Study on trends in energy efficiency in selected Caribbean countries

Bruno Lapillone

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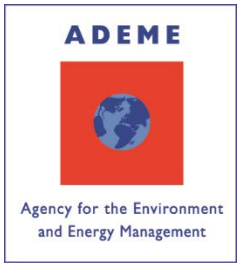

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The work was carried out under the supervision of Didier Bosseboeuf from ADEME and Ruben Contreras Lisperguer and Willard Phillips from ECLAC.

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Contents

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Introduction

A. Objectives and content

The objective of this report is to describe and compare energy efficiency trends in four countries in the Caribbean region: Barbados, Guyana, St Lucia and Trinidad. The report is based on data and indicators prepared under the BIEE project ("Base de Indicadores de Eficiencia Energética") on energy efficiency indicators developed by the Division of Natural Resources and Infrastructure of ECLAC, in close cooperation with ADEME, the French governmental agency on Energy Efficiency and Environment.

The BIEE project aims to develop a common methodology for the evaluation of national and regional energy efficiency trends, globally and by sector. This project relied on the experience of the ODYSSEE MURE project for European countries: this project, coordinated by ADEME, aims at evaluating energy efficiency progress through a large variety of indicators (ODYSSEE) and at describing energy efficiency policy and measures in EU countries (MURE).[1]

The BIEE project gathered participants from 23 countries, in different phases, starting with 6 countries of South America (Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay). It was then extended to 8 Central American countries (Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama), later to 5 other countries (Cuba, Ecuador, Colombia, Peru and Venezuela) and finally to 4 countries in the Caribbean region in 2017-2018. The last extension was coordinated by the ECLAC Subregional Headquarter for the Caribbean based at Port of Spain.

[1] http://www.odyssee-indicators.org/.

A first synthesis report covered 13 Central and Latin American countries and was published by ELAC/CEPAL in 2017[2].

The participants of the four Caribbean countries that participated to the project presented in this report are the following organizations:

- Division of Energy and Telecommunications, Office of the Prime Minister, Barbados.
- Guyana Energy Agency, Guyana.
- Renewable Energy Division, Sustainable Development Department, Saint Lucia.
- Ministry of Energy Industries, Trinidad and Tobago.

The main energy efficiency indicators produced from the BIEE project are presented in two interactive databases: one covering the 13 Central and Latin American countries[3] and a second one with only the 4 Caribbean countries[4].

B. Data sources

The collection of data required for the calculation of indicators began with the adaptation of the Excel template used for Latin and Central American countries to the situation of the 4 Caribbean countries[5].

The data template is organised in 7 main sheets corresponding each to a sector: macro (for general macro-economic and energy balance data), energy, industry, households, services, transport and agriculture. Annex 1 describes in more detail the data template and the process of data collection.

The work of data collection was performed by the organisations participating to the project, with the assistance of local consultants (see in Annex 2 the list of contributors). Each participant was responsible for collecting data from national institutions (Ministries, Statistical Institutes), power and gas utilities, oil companies, industry associations, banks etc. They have been guided throughout the project to fill in the data template by the technical coordination of the project, made of Enerdata, ECLAC and ADEME; in particular, the role of the technical coordination has been to help them adapt existing national data sources to the template categories.

A methodological guideline explains the definition and usual source of the data used in the data template and explains the energy efficiency indicators.

The project has demonstrated that there is a lot of data available in the different countries, but that the information is diffuse and scattered among different actors. Thus the project has contributed to identify the existing data sources and to centralise them in the data template.

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[2] The report covers 13 countries for which the data that have been validated : Argentina, Bolivia, Brazil, Chile, Costa Rica, DominicanRepublic, Ecuador, El Salvador, Mexico, Nicaragua, Panama, Paraguay and Uruguay. https://repositorio.cepal.org/bitstream/handle/11362/40809/S1601141_en.pdf (English version) or https://repositorio.cepal.org/bitstream/handle/11362/40505/1/S1600876_es.pdf (Spanish version).

[3] https://www.cepal.org/drni/biee/2.html#work3 (direct link at http://www.biee-cepal.enerdata.eu/).

[4] http://biee-cepal-database.enerdata.eu/datamapper-caraibes/.

[5] Simplification of units as the countries are much smaller especially Barbados and Saint Lucia; addition of bauxite mining as it is significant in Guyana.

C. Main results

The main outputs and deliverables of this BIEE project on energy efficiency indicators for the Caribbean region are the following:

- Training materials to enhance the experience of Ministries in the construction of indicators and in the interpretation and analysis of energy efficiency trends (capacity building).
- A framework for data collection and updating (the "data template").
- Completed and validated data sets by country for 4 countries covering the period 2000 to 2015/16[6].
- A regional database on energy efficiency indicators with data for 13 Latin American countries containing around 80 different energy efficiency indicators by country with the data used to calculate them.
- A synthesis report describing energy efficiency trends in the four Caribbean countries (this document).
- National reports by country describing in more details energy efficiency trends by country, available on the BIEE web site http://www.cepal.org/drni/biee/[7].

In order to sustain the project and the calculation of energy efficiency indicators, the data collection process should be institutionalized, to simplify the updating of the data base.

- There are serious data gaps in the transport sector (stock of vehicles and traffic).
- The work done so far focused on a statistical approach to measure energy savings: efforts should be done to link these measures to a bottom-up evaluation of programmes, so as to have an extended evaluation of the observed indicators and to relate them with the energy savings from the programmes implemented by the countries.

[6] 2016 for Barbados and Guyana.

[7] https://www.cepal.org/drni/biee/3.html#work; 10 reports are available: Argentina, Brazil, Chile, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay and Uruguay.

I. Energy consumption and intensity trends

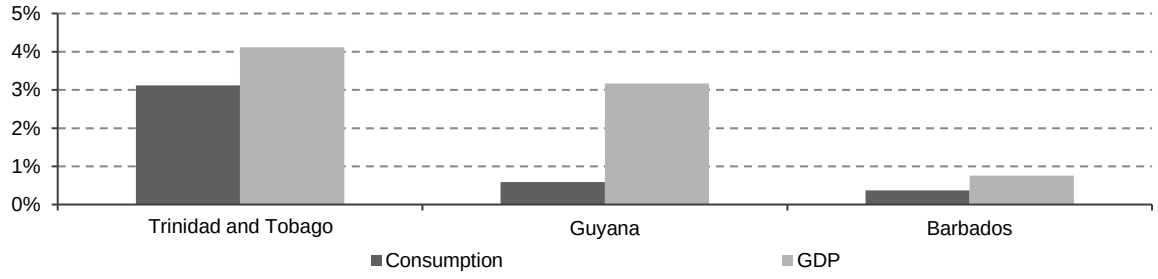
A. Trends in energy consumption

1. Primary energy consumption

Total energy consumption, also called primary energy consumption[8], includes final energy consumption and consumption and losses of the energy sector (also called transformation sector) as well as consumption for non-energy uses. The final energy consumption includes the consumption in industry (excluding energy industries), transportation, residential, services and agriculture.

As in most Latin American countries, primary energy consumption is also growing slower than GDP in our sample of Caribbean countries[9]. The decoupling between energy consumption and GDP growth was especially significant in Guyana (with a consumption increase below 1%/year despite a significant economic growth) and, to a lesser extent in Barbados, with consumption growing twice slower than GDP (Figure 1).

Figure 1
Primary energy consumption and GDP trends
(Percentage/year, 2000-2015)

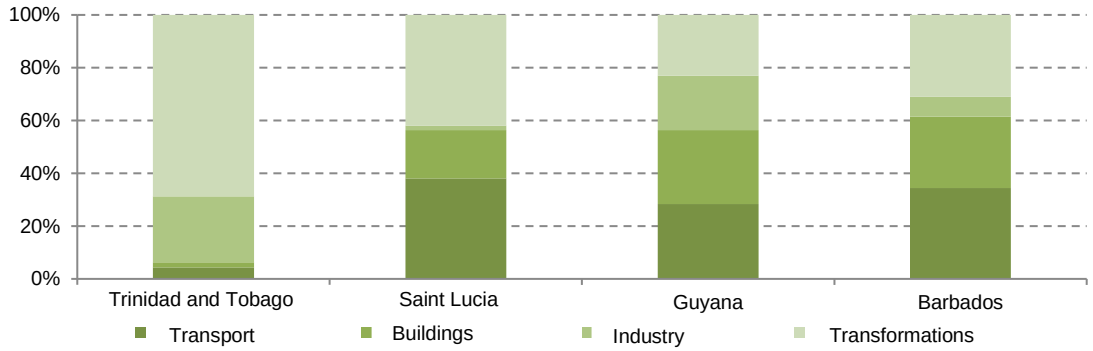


Source: BIEE Cepal.

[8] It is called TPES, Total Primary Energy Supply, by IEA or "Oferta Totale" by OLADE.
[9] Data on energy consumption are only available for 3 years for Saint Lucia.

Transformations (i.e. energy industries such as power and hydrocarbons sectors) absorb a high share of total energy consumption in Trinidad and Tobago (around 70%), as well as in St Lucia (40%).The share of transport is around 35% in St Lucia and Barbados. In Trinidad and Tobago and in Guyana, industry has a share around 20-25%, while this sector is negligible in the two other countries. Buildings have the highest share of total consumption in Guyana and Barbados (30%) (Figure 2).

Figure 2
Primary energy consumption by main sector (2015)[a]
(Percentages)



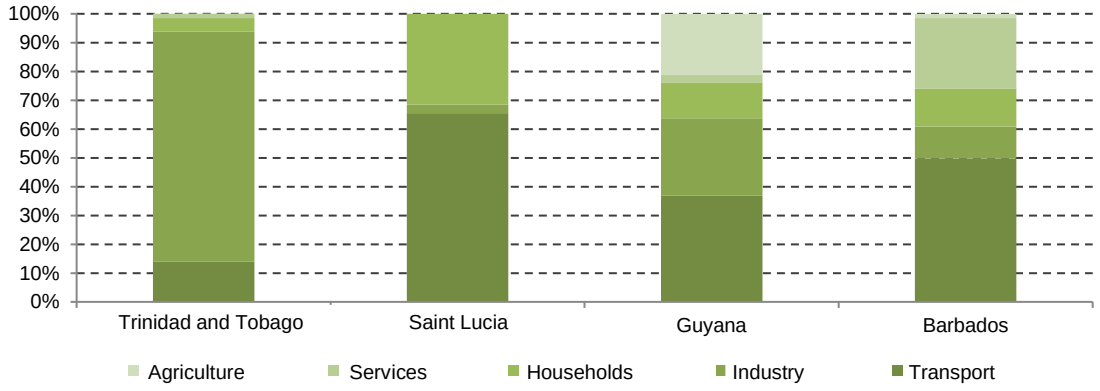
Source: BIEE Cepal; buildings: households, services and agriculture.

[a] Saint Lucia 2012.

2. Final consumption

Transport accounts for the highest share of final energy consumption in St Lucia (65%) and Barbados 50%)(Figure 3). Industry has a very important contribution in Trinidad and Tobago, one of the highest in the world (80%). Households absorb the largest share of this final consumption in St Lucia (around 30%). Services, because of the large hotel industry, have a significant share in Barbados (24%). Guyana is the only country where agriculture is important in the final energy consumption (21%).

Figure 3
Breakdown of final energy consumption by sector (2015)[a]
(Percentages)

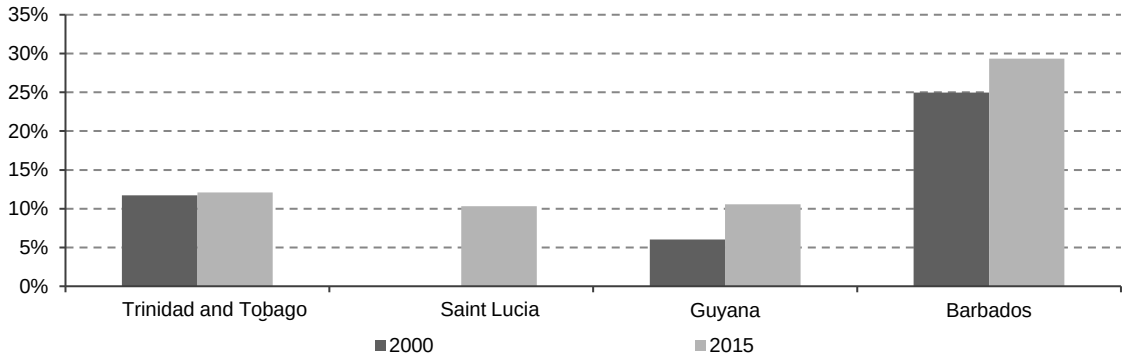


Source: BIEE Cepal.

[a] Saint Lucia 2012.

Electricity is at the heart of economic and social development of all these countries. Its share in the final energy consumption grew in our sample of Caribbean countries **(**Figure 4**):** the highest increases have been observed in Guyana and Barbados[10] (+4.5 points between 2000 and 2015).This increasing trend is linked to demographic change, industrialization, development of ICTs (Information and Communication Technologies) and air conditioning in services, as well as to the increasing ownership of households appliances (refrigerators, TV and air conditioning) and, in the case of Guyana, to the electrification of rural areas.

Figure 4
Share of electricity in the final energy consumption[a]
(Percentages)



Source : BIEE Cepal.

[a] Saint Lucia: 2012.

B. Trends in primary and final energy intensities

The most common indicator used to evaluate the overall energy efficiency performance of countries is the primary energy intensity, i.e. the total amount of energy required to produce one unit of GDP. However, the energy intensity appears more as an indicator of "energy productivity" than a real indicator of energy efficiency, from a technical point of view or in relation to energy efficiency policies.

Energy intensity is nonetheless the only indicator that allows comparing the overall energy efficiency performance between countries, even if the observed differences also include other factors not linked to energy efficiency, such as: (i) the economic structures, namely the contribution of the different sectors to GDP, (ii) the power generation mix (thermal and renewable), (iii) the importance of other transformations (as in the case of Trinidad and Tobago with the hydrocarbon sector), (iv) the climate, and (v) lifestyles and economic development in general. The effect of climate is probably negligible among this sample of countries.

When comparing energy intensities, GDP need to be converted from national currencies to a common currency, for instance US$. Conversions are usually made on the basis of market exchange rates, which raised two problems :

- The relative energy intensities between countries (the "ranking") are affected by the fluctuations in market exchange rates, which can vary quite a lot, even if the relative energy productivity did not change.

[10] Same trend as in Nicaragua, Ecuador and Paraguay.

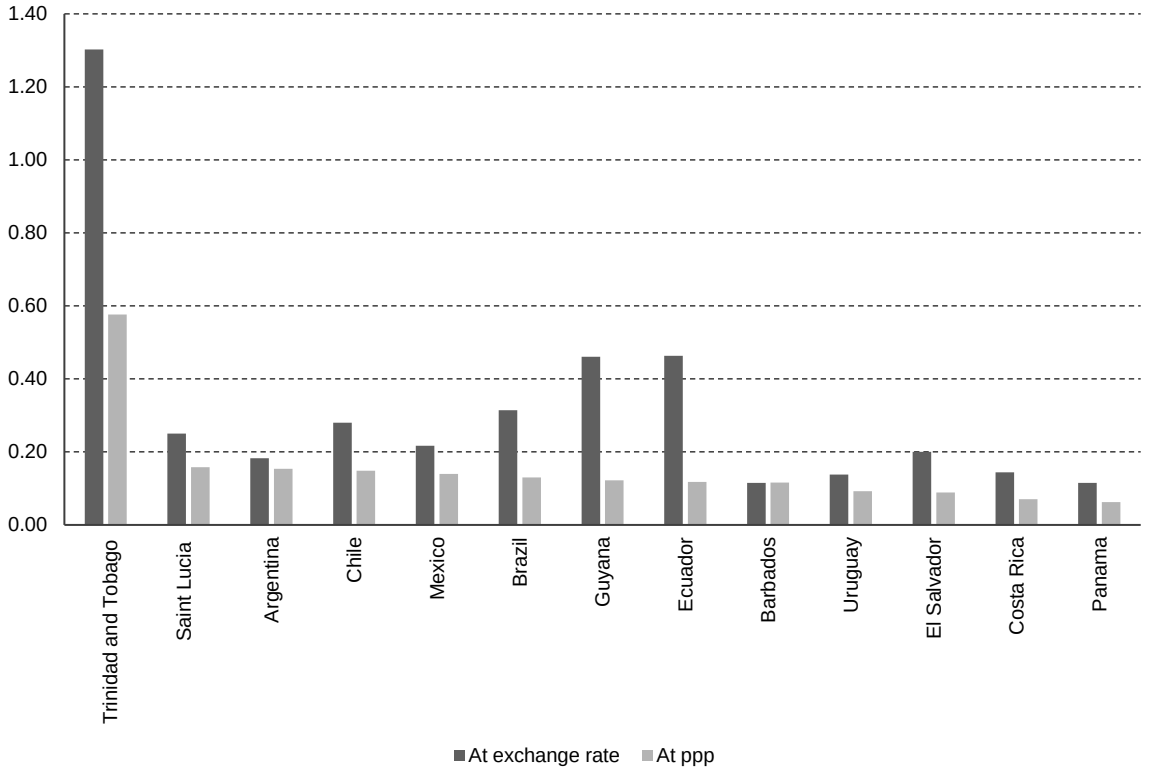
- This conversion does not reflect the fact that consumer prices are on average quite different among countries; for instance between Guyana and Barbados (by around 50% according to World Bank/IMF), and even more if comparison is made with OECD countries. [11]

For these reasons, comparisons of economic indicators among countries are more relevant if they are based on purchasing power parities rather than on exchange rates.

In the sample of Latin American countries shown in Figure 5, the primary intensities at exchange rates vary in a range of a factor 13 between the lowest levels (Uruguay, Panama and Costa Rica) and the highest value (Trinidad and Tobago) or a factor 4 if we exclude Trinidad and Tobago, which is a specific case with its energy intensive industries (Figure 5). At purchasing power parities (ppp) the gap between countries is narrower (difference of 2.5 between the lowest values, Panama or Costa Rica, and the highest, St Lucia, Argentina or Chile, if we again exclude Trinidad and Tobago.

Using purchasing power parities reduces the intensity differences by increasing the value of GDP of the less developed countries with a lower cost of living (case of Guyana or Ecuador where the GDP is multiplied by a factor 4): the intensity at ppp is thus 4 times lower at ppp than at exchange rate for Guyana and Ecuador. For Trinidad and Tobago, the difference is a factor 2.

Figure 5
Primary energy intensity exchange rate versus purchasing power parity (2015)
(Koe/$2000)

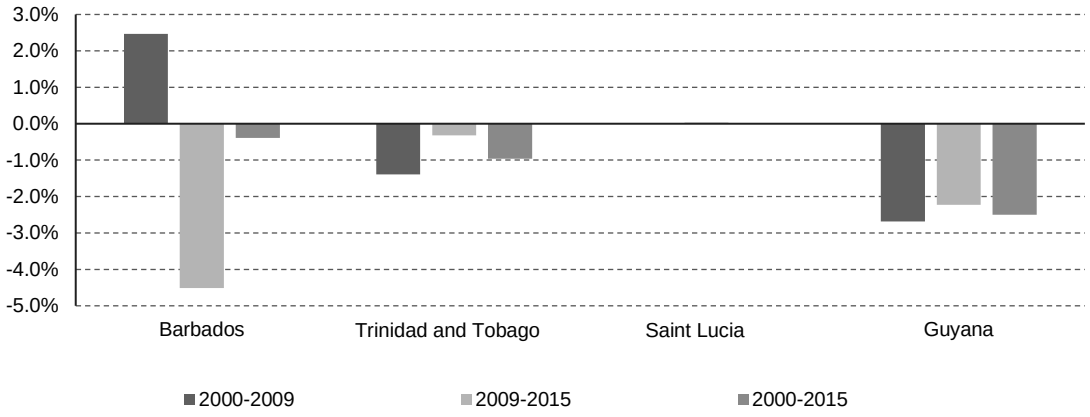


Source : BIEE Cepal.

[11] For instance, the average cost of living according to World Bank/IMF as measured with purchasing power parities is twice lower in Guyana than in France: this means that an income of 1000 $ in Guyana is equivalent to 2000 $ in France.

The primary energy intensity has been decreasing in Barbados, Guyana and Trinidad and Tobago (Figure 6). The reduction was quite rapid in Guyana (-2.5%/year) but moderate in Barbados and Trinidad and Tobago (less than -1%/year). Since the economic and financial crisis of 2009, the reduction has been slower in Trinidad and Tobago and in Guyana, but continued at the same pace as before in Guyana.

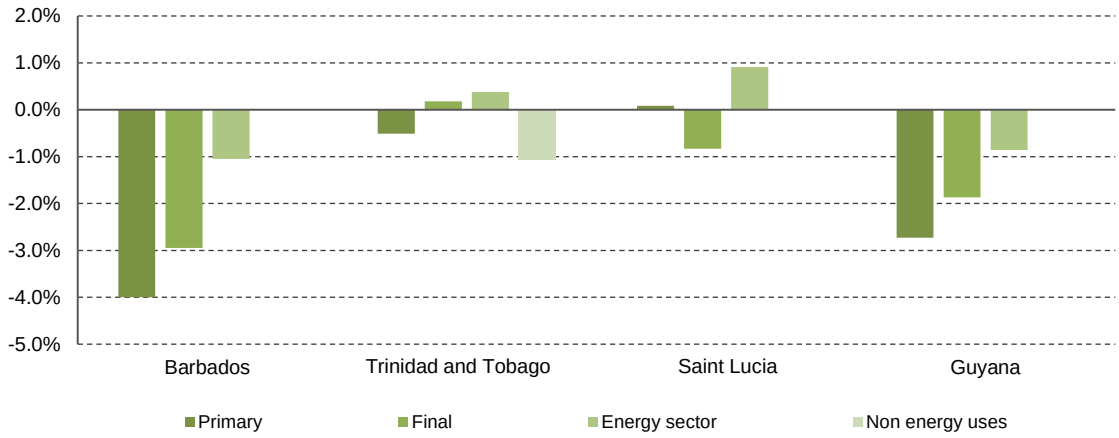
Figure 6
Primary energy intensity trends (2000-2015) [a]
(Percentage/year)



Source : BIEE Cepal.
[a] St Lucia 2010-2012.

The final energy intensity has been decreasing slower than the primary energy intensity for Barbados and Guyana. In other words, the energy productivity improved slower for final consumers: this trend is due to a lower consumption of the energy sector or for non-energy uses (that represents the difference between the primary and final consumption). In Guyana, this trend is explained by lower T&D power losses, while in Trinidad and Tobago, non-energy uses in the petrochemical industry are responsible for the faster decrease in the primary energy intensity.

Figure 7
Trends in primary and final energy intensity (2000-2015)
(Percentage/year)



Source : BIEE Cepal.

C. Trends in sectoral energy intensities

Sectoral industry intensities can be defined for industry, agriculture and services as the energy consumption of the sector over its value added. Industry far more energy intensive than services, by a factor 3 to 60 depending on the country (Figure 8).

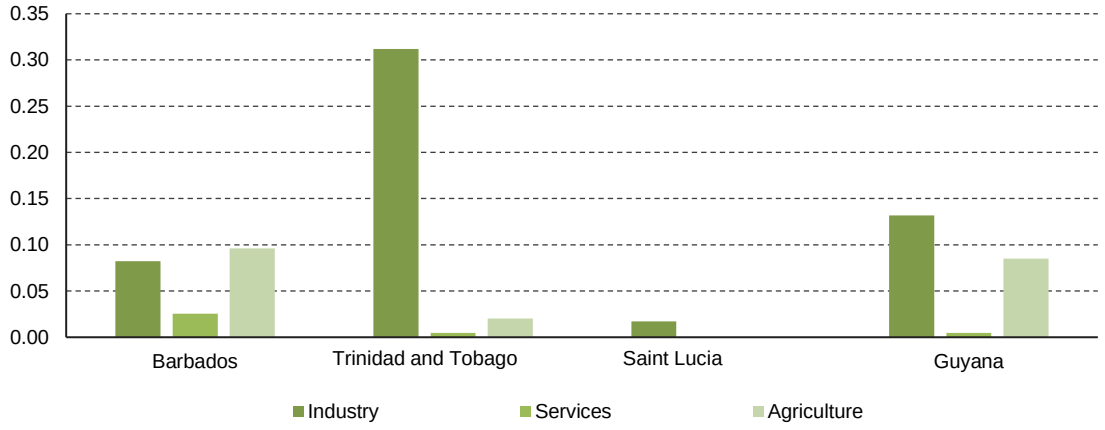
The industry intensity has been decreasing in all countries between 2000 and 2015 (Source: BIEE.

[a] Saint Lucia: 2012.

Figure 9).

The intensity of services increased rapidly in Barbados (by 1.6%/year) as well as in Trinidad and Tobago, however at a lower rate.

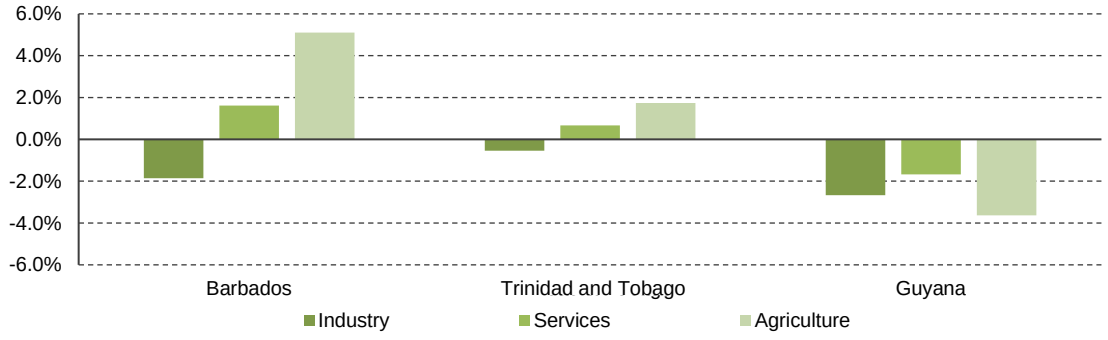
Figure 8
Sectoral final energy intensities (2015)[a]
(Koe/$oop)



Source: BIEE.

[a] Saint Lucia: 2012.

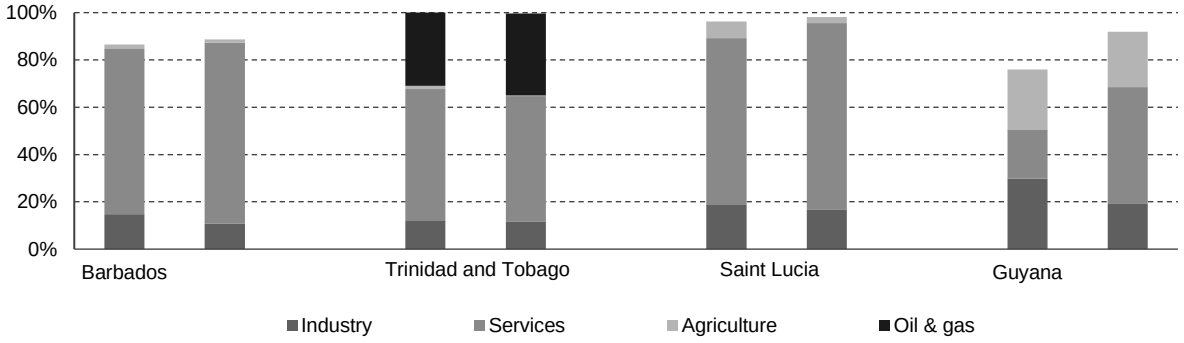
Figure 9
Trends in sectoral final energy intensities (2000-2015)
(Percentage/year)



Source: BIEE.

As all sectors do not have the same energy intensity, part of the variation in the final energy intensity may be due to structural changes in the GDP, i.e. in the contribution of the three main sectors in the GDP (agriculture, industry and services[12]). As the share of services in the GDP, the less energy intensive sector, is increasing (by 7 points in Barbados, 9 points in St Lucia and 29 points in Guyana) (Figure 10), this contributes to reduce the final energy intensity, all things being equal.

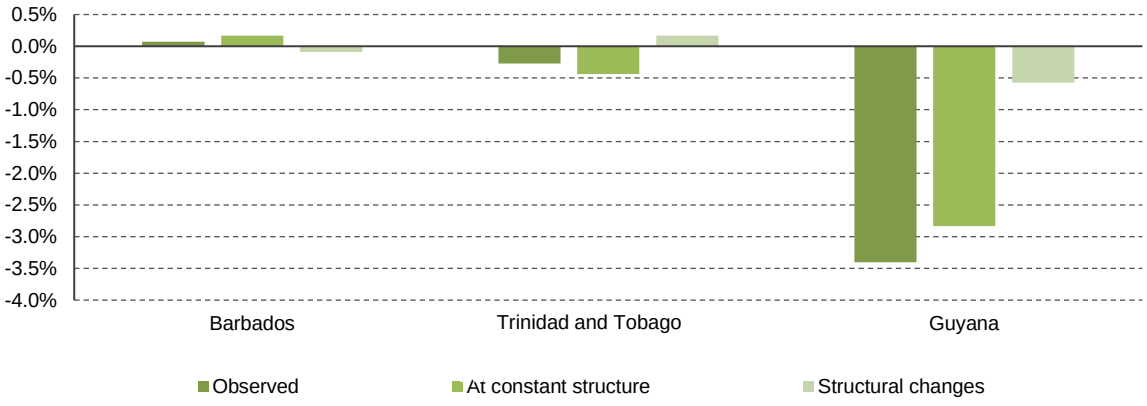
Figure 10
Change in the structure of the GDP (2000 -2015)
(Percentages)



Source: BIEE.

To assess the progress of energy efficiency in the different countries, it is more relevant to exclude these structural changes. This is obtained by calculating a final energy intensity at constant GDP structure, assuming a constant share of agriculture, industry and services in the GDP. The difference between the variations of the intensity at constant structure and the observed intensity shows the influence of these structural changes. In Guyana and Barbados structural changes in the GDP to less energy intensive sectors (mainly services) contributed to decrease the final energy intensity. In Guyana, 20% of the final intensity decrease is explained by structural changes. In Trinidad and Tobago structural changes did not impact the final energy intensity trends.

Figure 11
Impact of structural changes in the GDP on the final intensity (2000-2015)
(Percentage/year)



Source: BIEE Cepal.

[12] Trinidad and Tobago is characterised by a high share of the oil and gas sector (35% of GDP in 2015); it was separated from the rest of industry.

II. Energy efficiency trends in the energy sector

The consumption of the energy sector corresponds to the energy consumption and losses in energy transformations. It includes the net consumption for power generation[13], T&D power losses, as well as, in the case of case of Trinidad & Tobago, the consumption and losses in the oil and gas sector (production, refining, LPG or LNG plants).

In countries, with no major production of fuels and with a high share of thermal power, the consumption of the energy sector mainly corresponds to losses in thermal power plants: this is the case of Barbados, Guyana and St Lucia, where power generation represents 85 to 90% of the consumption of the sector.[14]

In Trinidad and Tobago, the net consumption of the power sector only represents 35% of the total consumption of the energy sector, because of the importance of the hydrocarbon sector which absorbs around 60% of this consumption.[15]

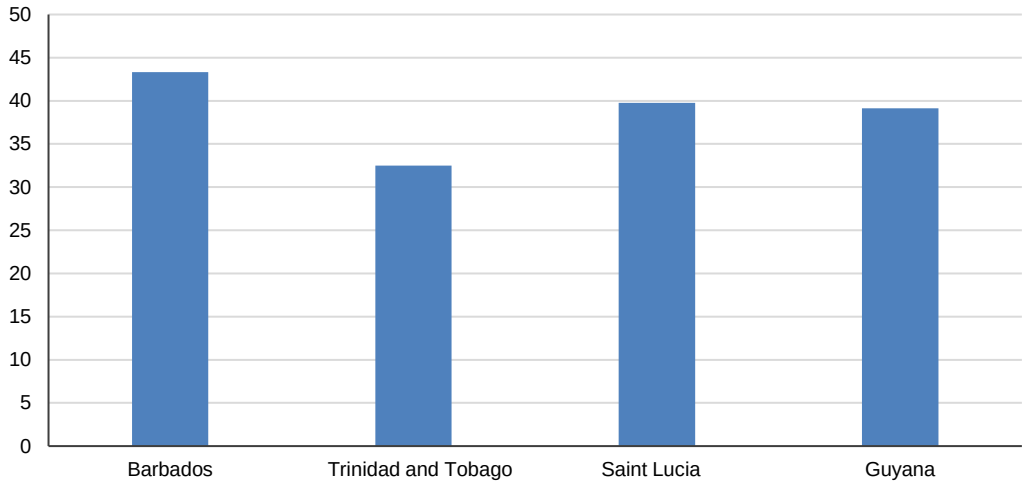
The average efficiency of power generation depends on the power mix, and especially the share of renewables as they have an efficiency of 100%, and on the efficiency of thermal production. This average efficiency is quite similar as countries rely mostly on thermal power plants (Figure 12).

[13] The net consumption of power generation is equal to the inputs for power generation minus the quantity of electricity produced. For hydro, wind and solar PV, the inputs is by definition equal to the output, as electricity generation from these sources is considered to have an efficiency of 100%: this means that in that case the net consumption is equal to zero.

[14] Over 90% in St Lucia, 83% in Barbados and Guyana.

[15] The rest goes to T&D losses of gas and electricity.

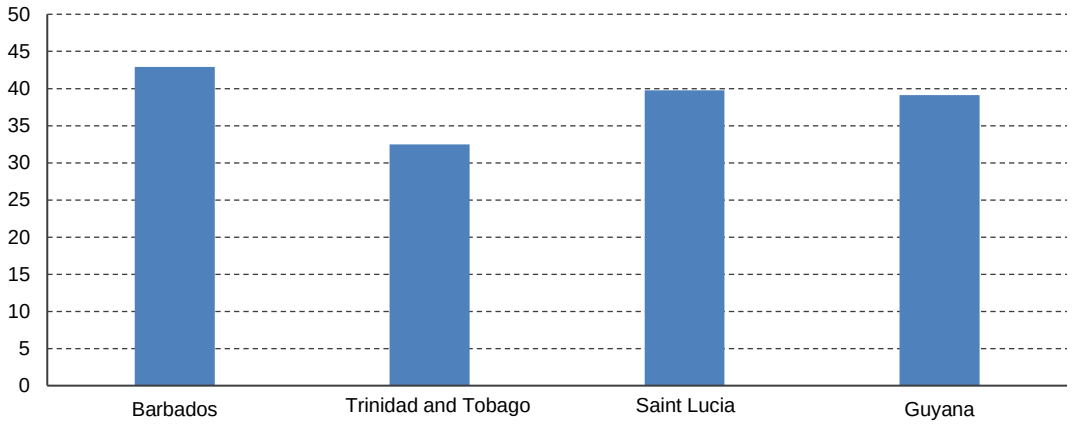
Figure 12
Efficiency of power generation (2015)
(Percentages)



Source: BIEE Cepal.

The efficiency of thermal power plants corresponds to the ratio of thermal electricity production over fuel inputs. For Trinidad and Tobago, St Lucia and Guyana, it is equal to the average efficiency of the power sector as thermal power plants are the only source of electricity (Figure 13).

Figure 13
Efficiency of thermal power generation (2015)
(Percentages)

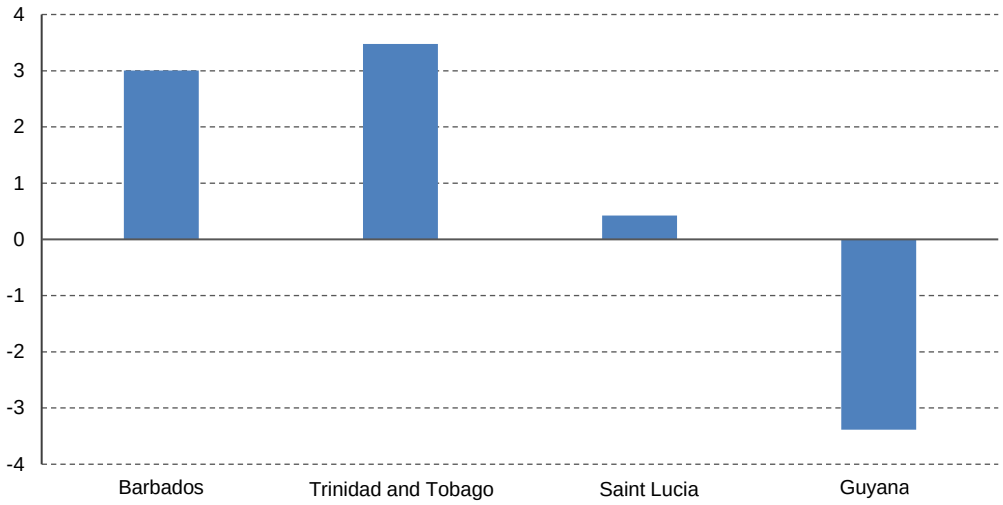


Source: BIEE Cepal.

The efficiency of power generation increased in Barbados due to the penetration of solar power plants (Figure 14). In Trinidad and Tobago, the penetration of gas combined cycles in the recent years (1200 MW installed between 2010 and 2015) should have led to an increase in efficiency, which is not visible, due to other factors.[16]

[16] Because of low gas prices, these combined cycles are probably not operated with the highest efficiency.

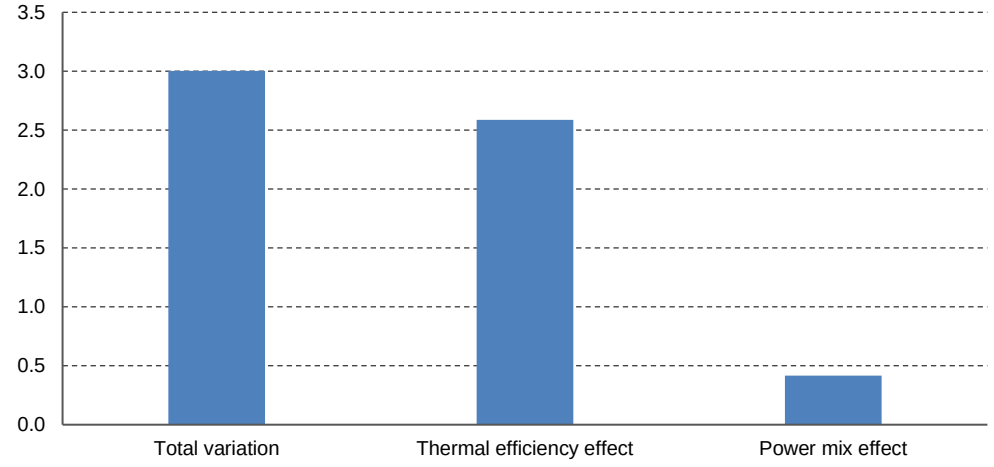
Figure 14
Trends in the efficiency of power generation (2000-2015)
(Points)



Source: BIEE Cepal.

In Barbados the increase in power generation efficiency between 2000 and 2015 (+3 points) is mainly explained by the increase in the efficiency of thermal generation, which explains 85% of this increase (Figure 15). The penetration of solar power plants is still too low (19 MW in 2016) to have a significant effect and only contributed to raise efficiency by 0.4 percentage points.

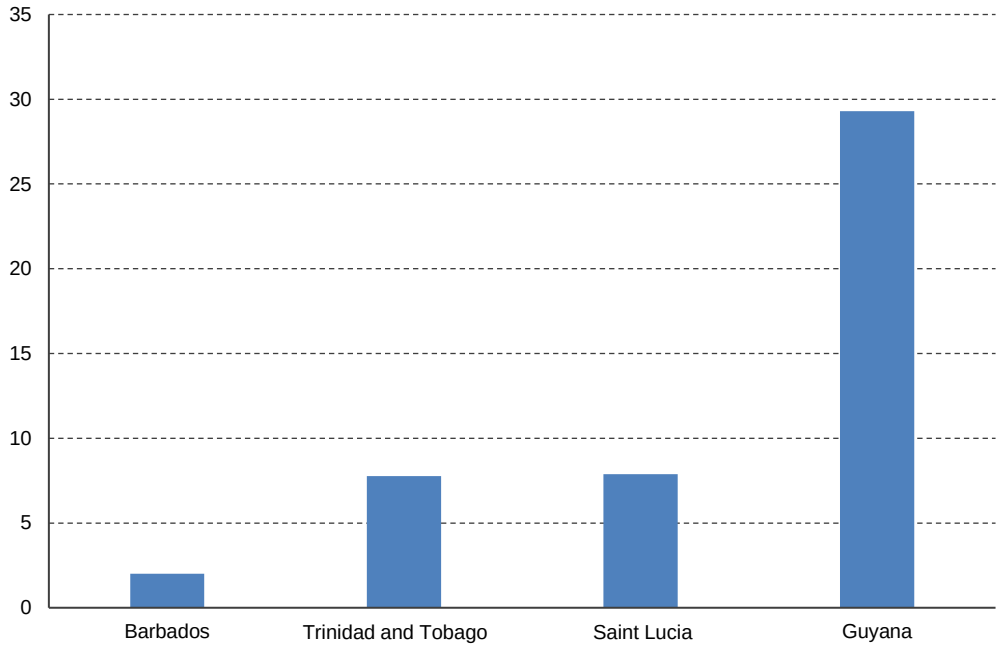
Figure 15
Factors of change in power generation efficiency Barbados (2000-2015)
(Points)



Source: BIEE Cepal.

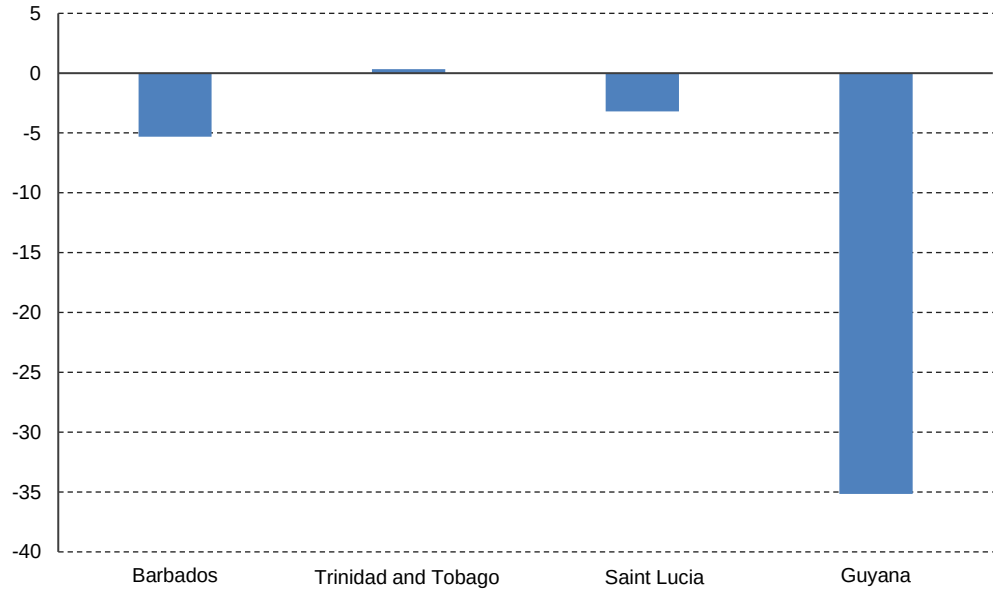
The rate of electricity transport and distribution (T&D) losses is below the Latin American's average in Barbados, Trinidad and Tobago and St Lucia (less than 10% compared to 15% for Latin America). It is very high in Guyana (around 30%) but has been decreasing significantly in Guyana since 2000 (by more than 35 points)(Figure 17).

Figure 16
T&D losses (2015)
(Percentages)



Source: BIEE Cepal.

Figure 17
Trends in T&D losses (2000-2015)
(Points)

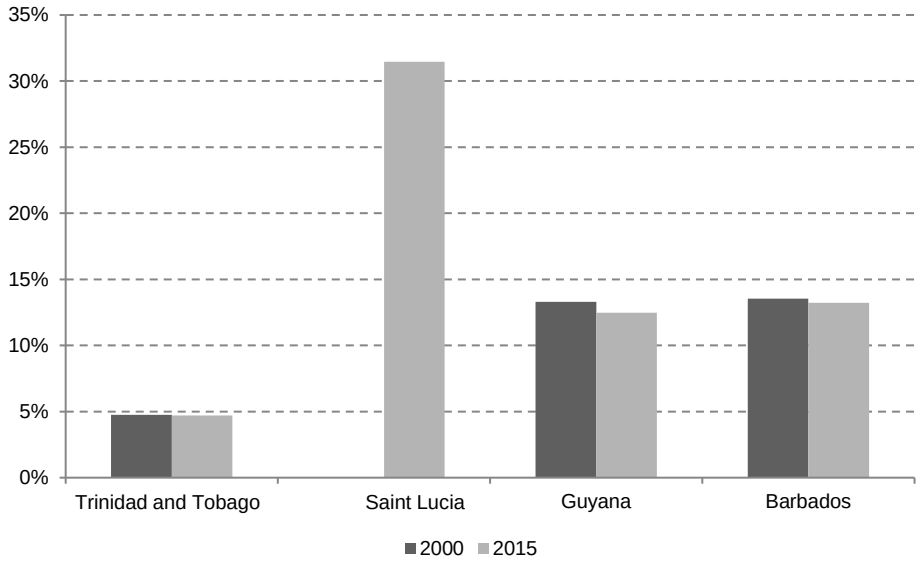


Source: BIEE Cepal.

III. Energy efficiency trends for households

The share of household in final energy consumption remained roughly stable between 2000 and 2015 and is generally low (below 15%), except in St Lucia where it reaches 30% (Figure 18).

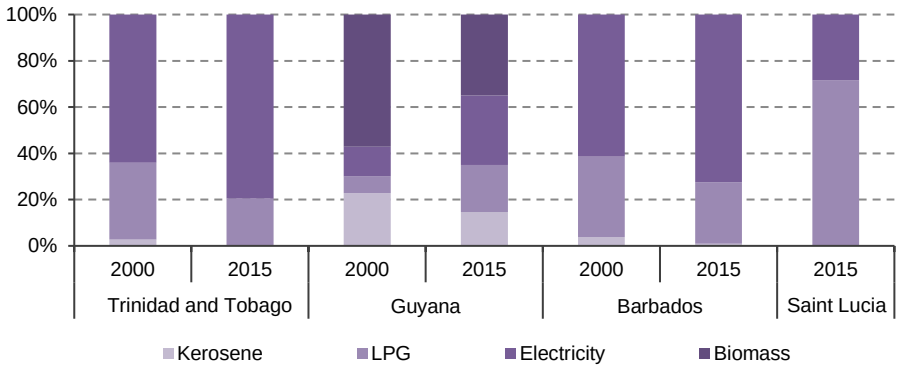
Figure 18
Share of households in final energy consumption
(Percentages)



Source: BIEE Cepal.

Electricity is the dominant source of energy in Barbados and Trinidad and Tobago and its share is increasing: it now exceeds 70%[17] (Figure 19). In Guyana and St Lucia the share of electricity is also progressing but is much lower (around 30%). Biomass is only used in Guyana but its market share is diminishing rapidly (from 57% in 2010 to 35% in 2015) and is replaced by LPG (progression from 7% to 20%).

Figure 19
Fuel mix of households energy consumption
(Percentages)



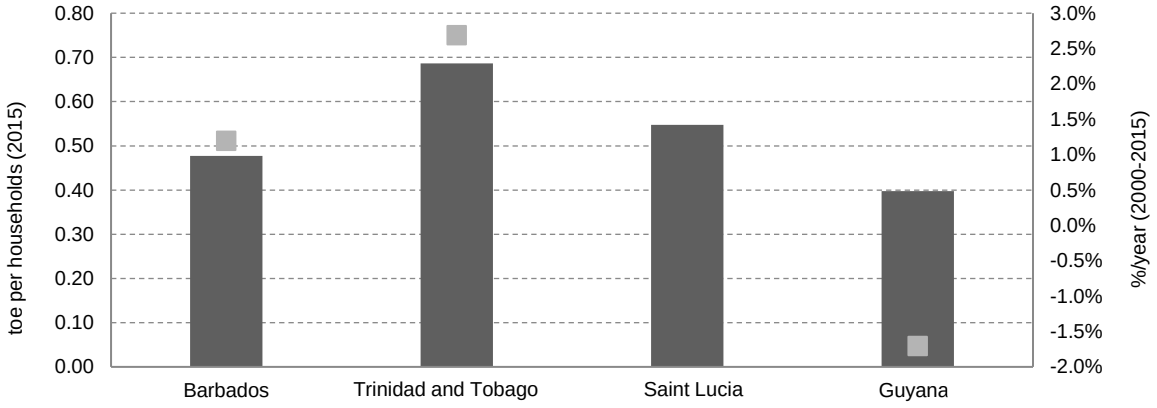
Source: BIEE Cepal.

A. Overall trends

The average energy consumption per household ("specific consumption") varies between 0.48 toe in Barbados and 0.69 toe in Trinidad and Tobago (Figure 20). It is similar to the majority of Latin American countries but twice lower than in Argentina or Chile, where there are heating needs.

This specific consumption is increasing in Barbados and Trinidad and Tobago (by 1.2 and 2.7%/year respectively), while it has been decreasing in Guyana with the substitution of biomass by LPG.

Figure 20
Average energy consumption per household
(Toe per households & percentage/year)

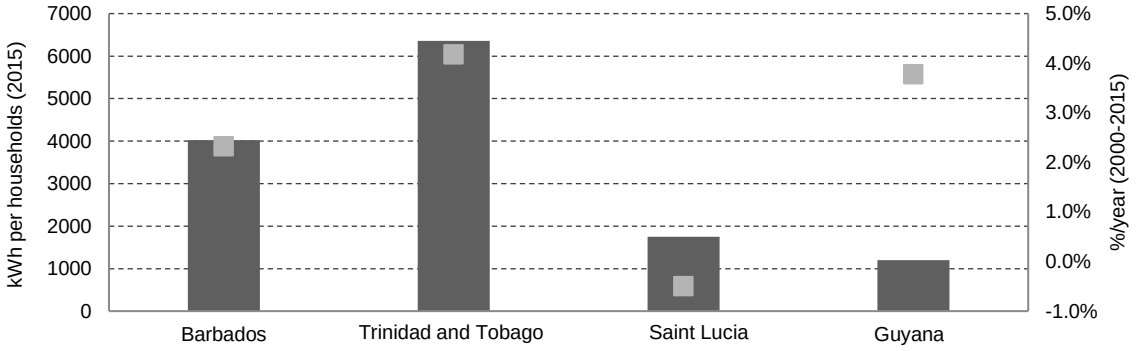


Source: BIEE Cepal.

[17] Respectively 73% and 80% in Barbados and Trinidad and Tobago in 2015.

The average electricity consumption per household varies significantly among the four countries, from 1200 kWh per household in Guyana to 6400 kWh in Trinidad and Tobago (Figure 21)[18]. It has been increasing significantly for all countries except St Lucia (2-4%/year) due to a growth in equipment ownership (refrigerators, TV, ICT, air conditioning, water heater) and electrification.

Figure 21
Average electricity consumption per household

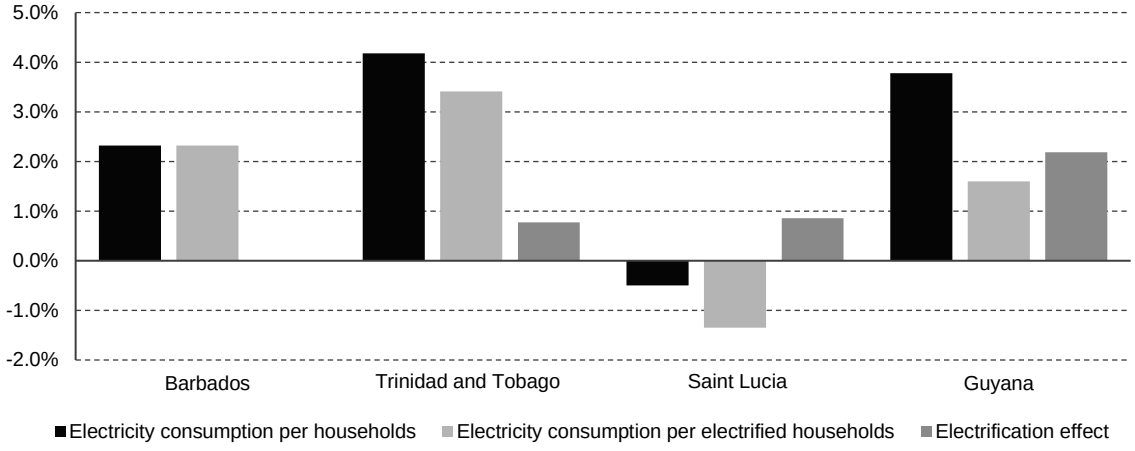


Source: BIEE Cepal.

For Trinidad and Tobago and Guyana, the specific consumption per electrified household increases less rapidly than per household; the difference shows the effect of rural electrification (Figure 22).

The electrification rate increased significantly in Guyana, by more than 25 points between 2002 and 2015; this explained two third of the growth in electricity consumption per household from 2002 to 2015. In St Lucia, the specific consumption has decreased slightly; the reduction was more rapid for electrified household as the electrification effect contributed to increase this specific consumption by 0.9%/year. In Barbados, the electrification rate was already close to 100%.

Figure 22
Effect of household electrification on the unit electricity consumption
(Percentage/year)



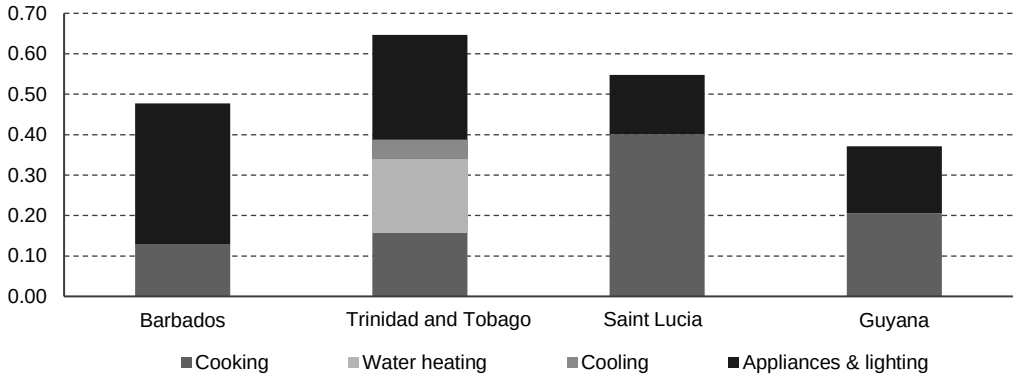
Source: BIEE Cepal.

[18] This can be compared to a range from 850 kWh per household in Bolivia, to 1700 kWh in Mexico and 3000 kWh in Argentina, for other BIEE countries from Latin and Central America.

B. Energy consumption by end-use

Cooking is the dominant end-use in Guyana and St Lucia (equal or above 50%). In Trinidad and Tobago, water heating represents around 30% of the consumption of households (**Figure 23**).

Figure 23
Energy consumption per dwelling by end-use (2015)[a]
(Toe/hh)

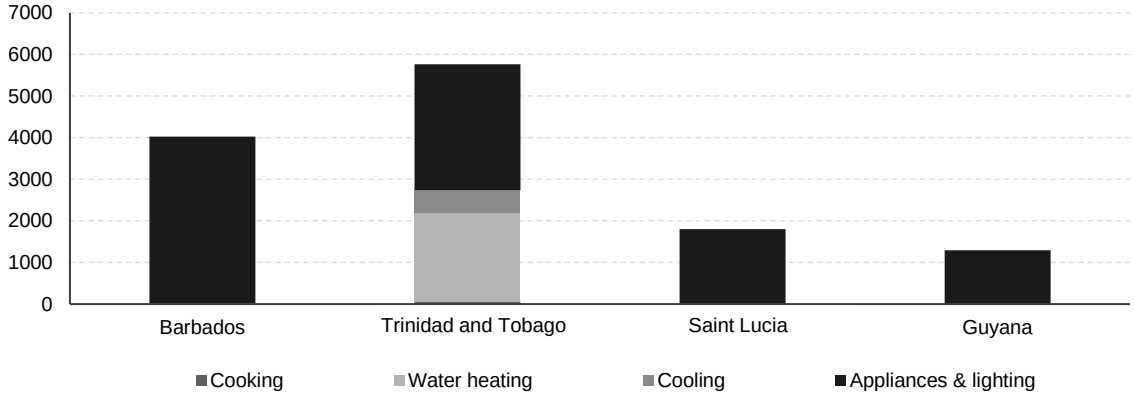


Source: BIEE Cepal.

[a] 2012 for Saint Lucia and 2011 for Trinidad and Tobago; air cooling and water heating included in appliances & lighting for Barbados, Saint Lucia and Guyana.

Appliances and lighting is the dominant electricity end-use (Figure 24). In Trinidad and Tobago, air Cooling represents around 10% of the average electricity consumption per household.

Figure 24
Electricity consumption by end–use[a]
(Kwh/hh)

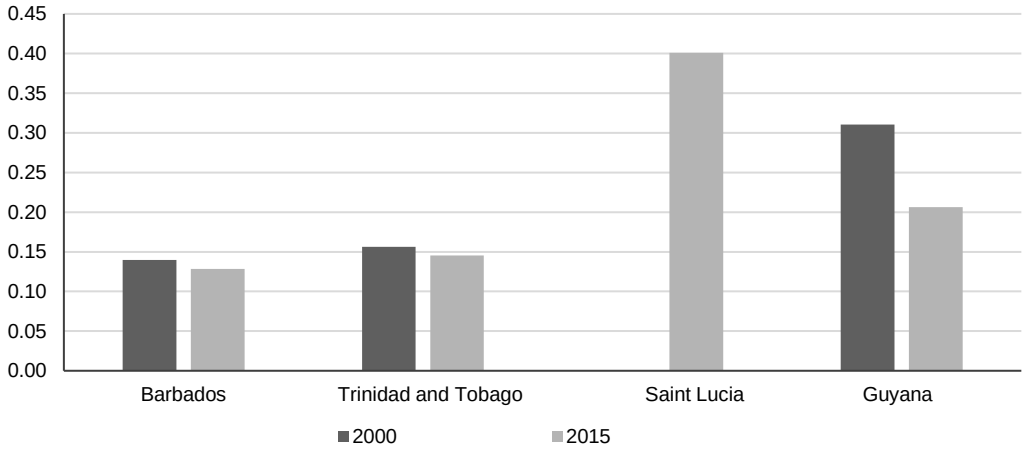


Source: BIEE Cepal.

[a] 2012 for Saint Lucia and 2011 for Trinidad and Tobago; air cooling and water heating included in appliances & lighting for Barbados, Saint Lucia and Guyana.

In Trinidad and Tobago and in Barbados, the energy consumption per household for cooking slightly decreased. This specific energy consumption varies strongly across countries depending on the share of biomass as biomass is much less efficient than LPG or gas: from 0.13 toe/household in Barbados to 0.40 toe in St Lucia where biomass is the main fuel consumed.

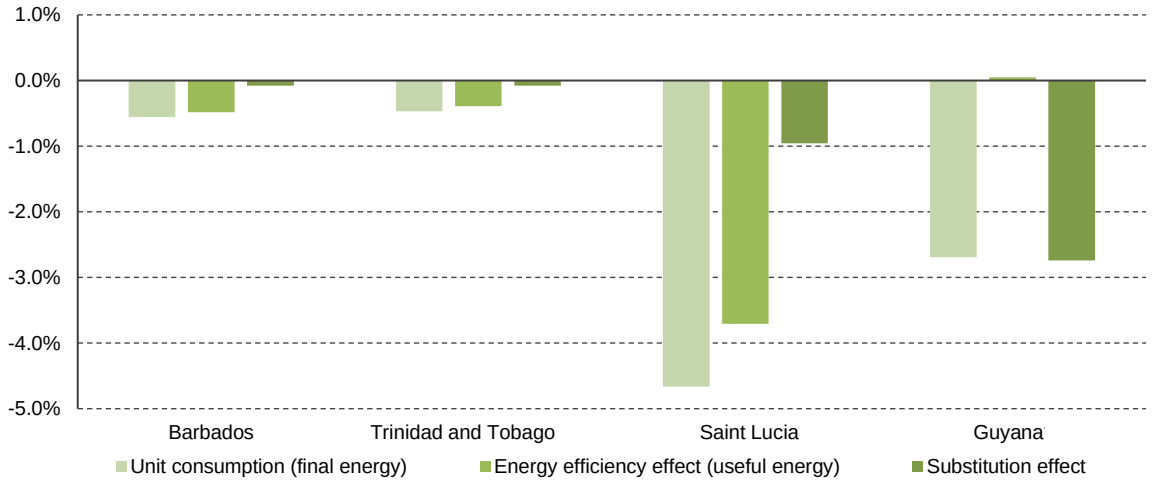
Figure 25
Unit consumption per household for cooking
(Toe/dwelling)



Source: BIEE Cepal.

The effect of substitution from biomass to modern fuels was the greatest in Guyana, with a substitution from biomass to LPG. In Guyana, most of the rapid decrease in the specific consumption (around 3%/year) is explained by this substitution (Figure 26)[19].

Figure 26
Consumption for cooking per dwelling and substitution
(Percentage/year)



Source: BIEE, Cepal.

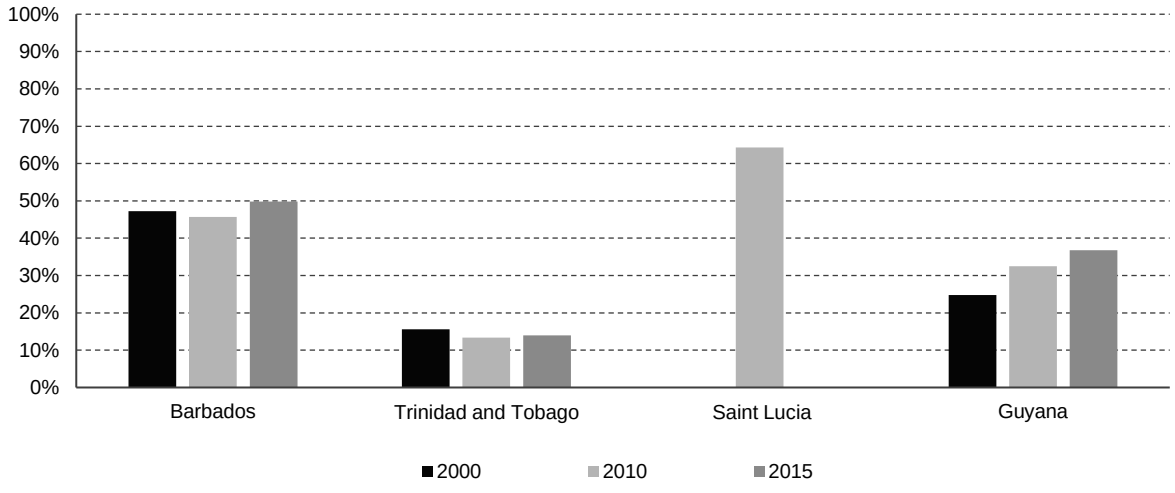
[19] The substitution effect for cooking was calculated as the difference between the annual change in specific energy consumption per dwelling in final energy and useful energy. The energy efficiency effect is measured by the variation of specific consumption in useful energy The value in useful energy is calculated by multiplying the final consumption of each fuel by its average energy efficiency (i.e. 45% for LPG and gas, 80% for electricity, 10% for charcoal and 5 % for wood).

IV. Energy efficiency trends in transport

A. Trends in consumption

The share of transport sector in final energy consumption ranges from around 15% (Trinidad and Tobago) to 65% (St Lucia) (Figure 27). It has generally increased in countries where it was the dominant sector.

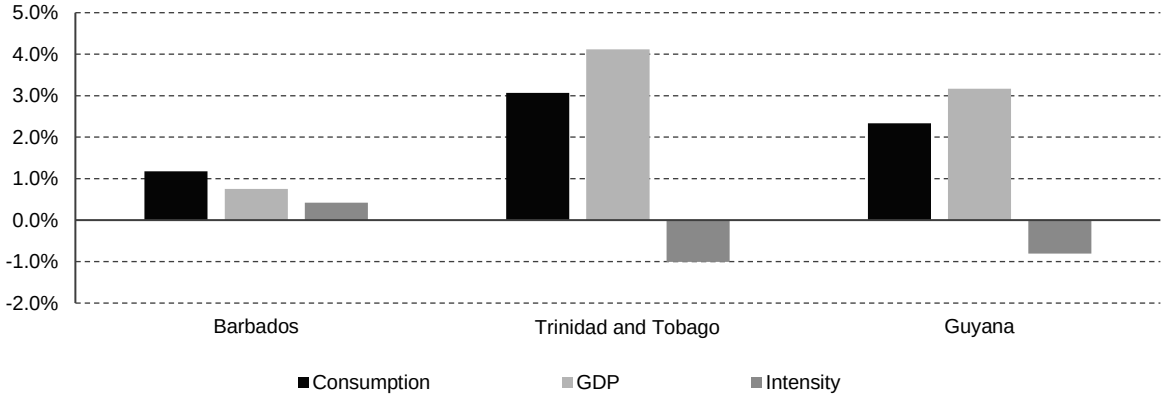
Figure 27
Share of transport in final energy consumption
(Percentage/year)



Source: BIEE, Cepal.

In Trinidad and Tobago and in Guyana transport consumption grew less rapidly than GDP from 2000 to 2015 (Figure 28). Consequently, the intensity of transport[20] has decreased by around 1%/year in both countries. In Barbados there was a reverse trend with a 0.4%/year increase in this intensity.

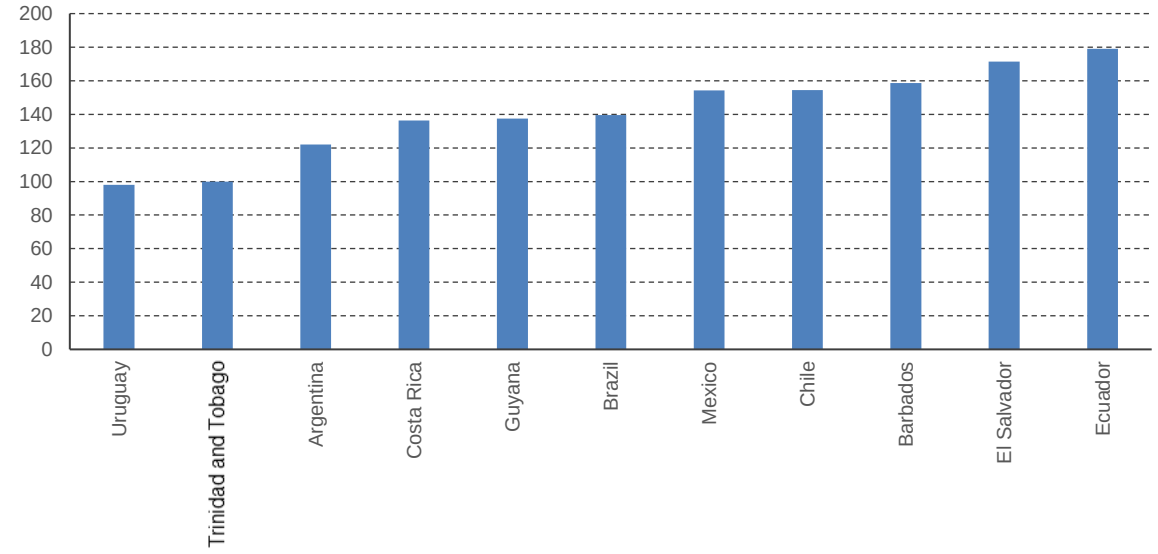
Figure 28
Trends in transport consumption, GDP and transport intensity (2000-2015)
(Percentage/year)



Source: BIEE, Cepal.

Trinidad and Tobago has a rather low energy intensity of transport compared to other countries of the region (Figure 29). The intensity level of transport is 80% higher in Ecuador or El Salvador, than in Trinidad and Tobago or Uruguay, the countries with the lowest value. It is respectively 40% and 60% higher in Guyana and Barbados compared to Trinidad and Tobago or Uruguay.

Figure 29
Energy intensity of transport
(Trinidad and Tobago=100)

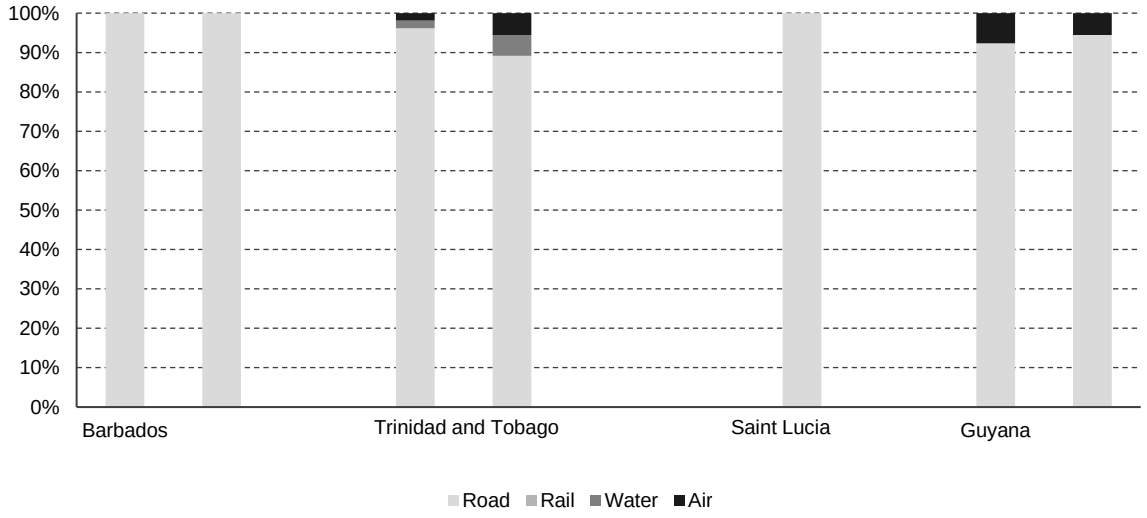


Source: BIEE, Cepal.

[20] The energy intensity of transport is defined in relation to GDP as all sectors contribute to passenger and freight traffic, and thus to the energy consumption in transport. Using the value added of transport would be misleading as it only accounts for the activities of transport companies and exclude cars, most light duty vehicles and industrial trucks.

Road transport is the main transport mode: it accounts for over 90% of the consumption in all countries by 2015. The share of road transport remained relatively stable since 2000 (Figure 30).

Figure 30
Transport energy consumption by mode (2000, 2012)
(Percentages)

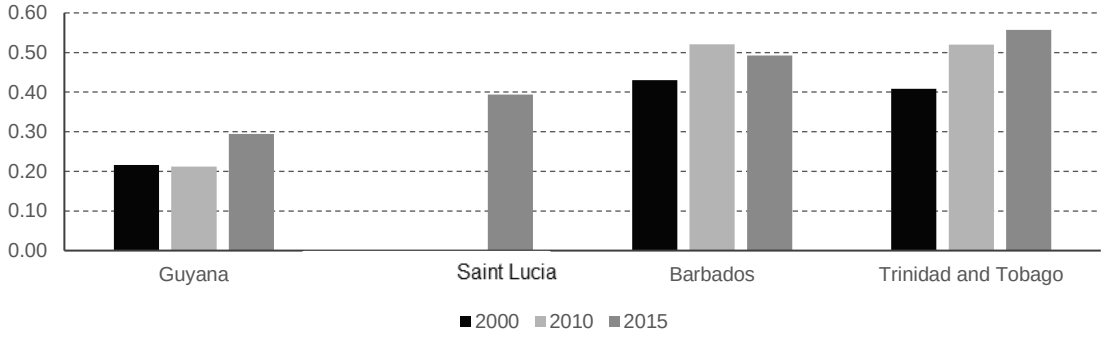


Source: BIEE, Cepal.

B. Road transport

The energy consumption of road transport per capita is quite high in Trinidad and Tobago and Barbados, however with a little progression in recent years. In contrast, in Guyana, which is the country with the lowest level, this consumption had a much higher progression.

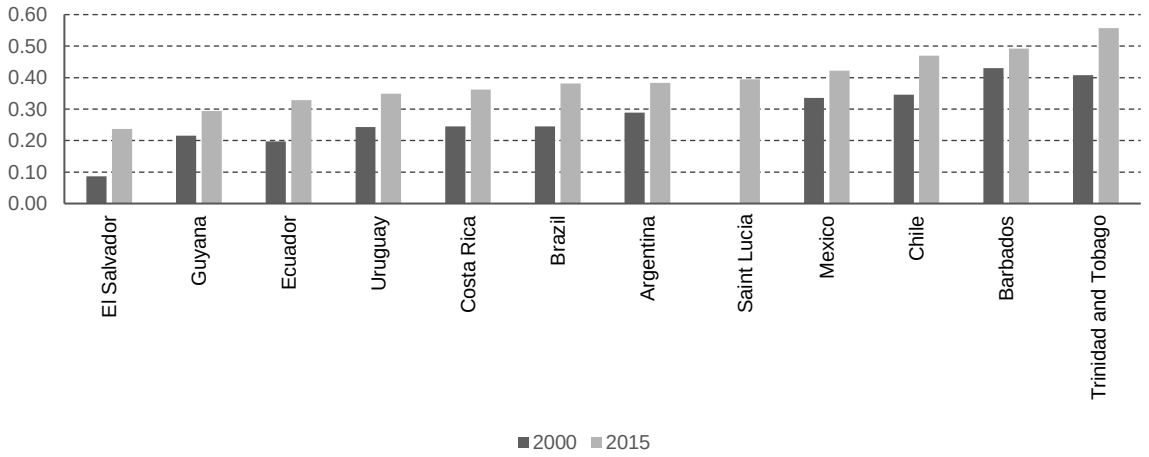
Figure 31
Consumption of road transport per capita
(Toe/cap)



Source: BIEE, Cepal.

Compared to other countries of the region, the energy consumption of road transport per capita of Trinidad and Tobago and Barbados appears to be the highest but remains among countries with the slowest progression (Figure 32).

Figure 32
Consumption of road transport per capita in selected countries
(Toe/cap)

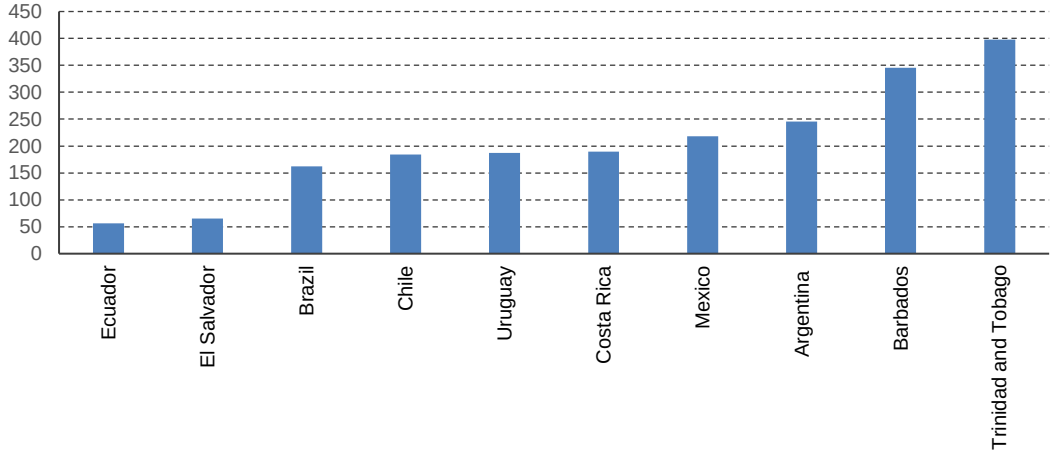


Source: BIEE, Cepal.

Road transport per capita depends on the number of vehicles per capita and the specific consumption per vehicle (toe /vehicle). The first factor can be captured by the average number of cars per capita (Figure 33), while the second one can be measured by the average consumption of road transport per vehicle (Figure 34).

Trinidad and Tobago and Barbados are by far the countries with the highest number of cars per capita (Figure 33).

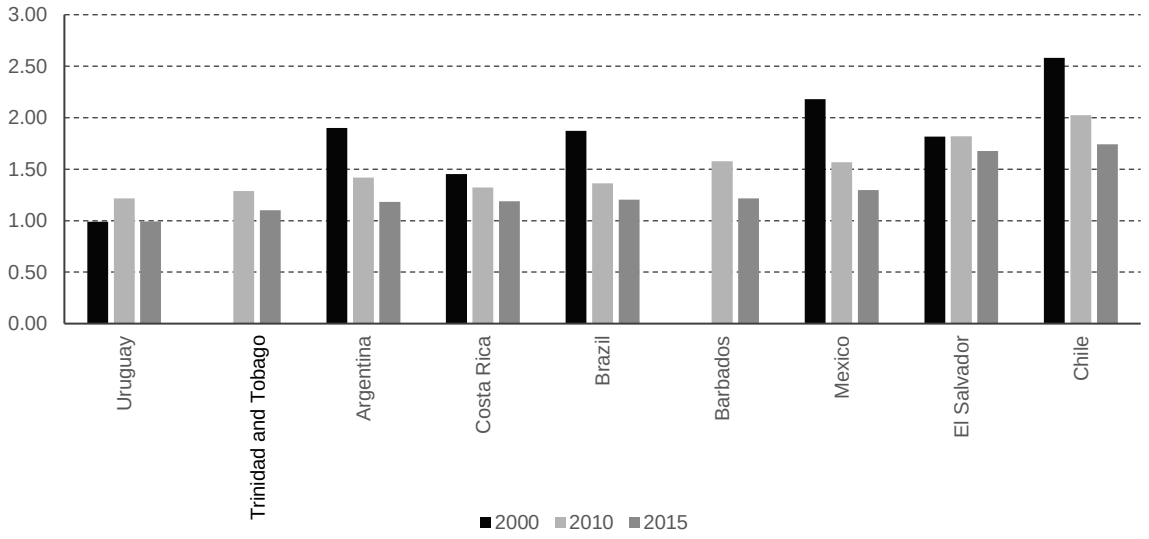
Figure 33
Car ownership (2015)
(Cars/1000 inhabitants)



Source: BIEE, Cepal.

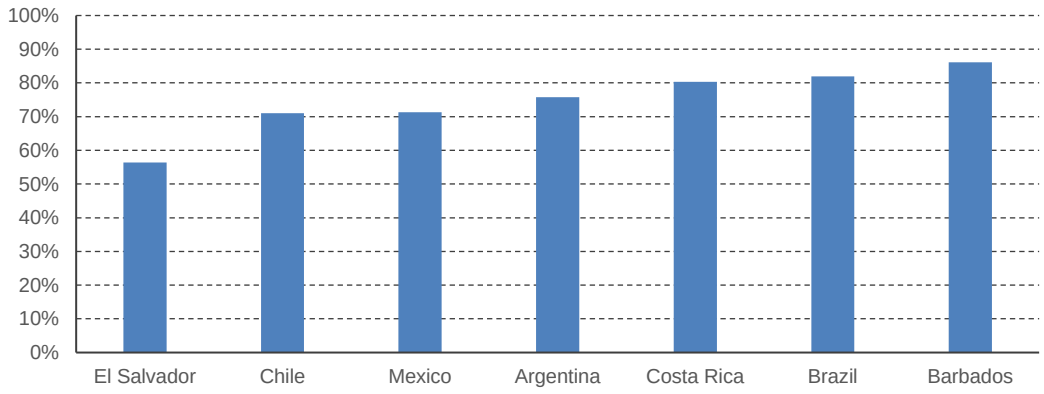
Trinidad and Tobago is among the countries with the lowest consumption per vehicle and Barbados is in the middle of the sample of countries (Figure 34). This position depends on the efficiency of vehicles, their use (km/year) but also the composition of the stock of vehicles (i.e. the share of light vehicles, and in particular cars). Barbados is the country with the highest share of cars in the stock of vehicles (Figure 35).

Figure 34
Road transport consumption per vehicle
(Toe/veh)



Source: BIEE, Cepal.

Figure 35
Share of cars in the total stock of vehicles (2015)
(Percentages)



Source: BIEE, Cepal.

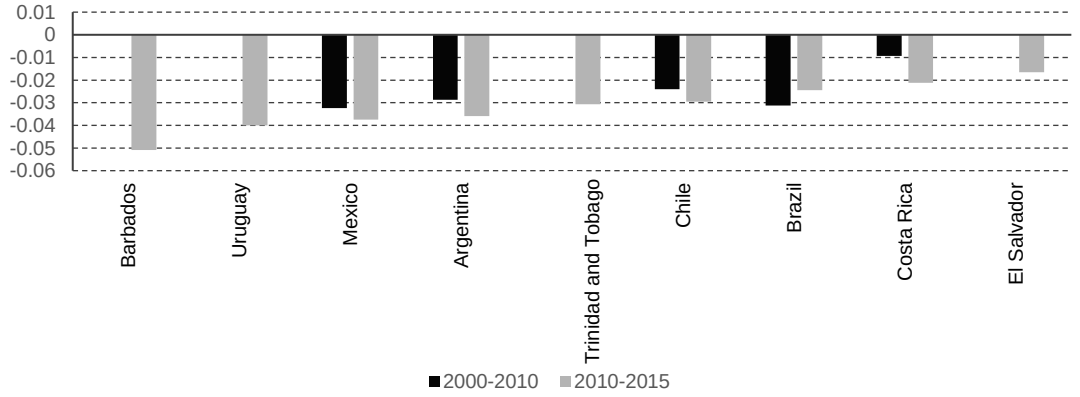
The average fuel consumption per vehicle has been generally decreasing in most countries as shown in Figure 36. This trends reflects the improved efficiency of vehicles but also change in the composition of the stock of vehicles (share of light vehicles, and in particular cars).

Figure 36
Trends in road transport consumption per vehicle
(Toe/veh)

Source: BIEE, Cepal.

The overall energy efficiency of road vehicles can be evaluated by calculating an average energy consumption per car equivalent, calculated as the ratio between the total consumption of road transport and the total fleet of road vehicles expressed in car equivalent.[21] The difference between the energy consumption of road transport per vehicle and per car equivalent corresponds to the effect of changes in the composition of the vehicle stock. Energy efficiency improvements can be better evaluated with the variation of the unit consumption per car-equivalent, as this indicator is cleaned from changes in the vehicle fleet (Figure 37).

Figure 37
Trends in unit consumption of road transport (2000-2012)
(Percentage/year)



Source: BIEE, Cepal.

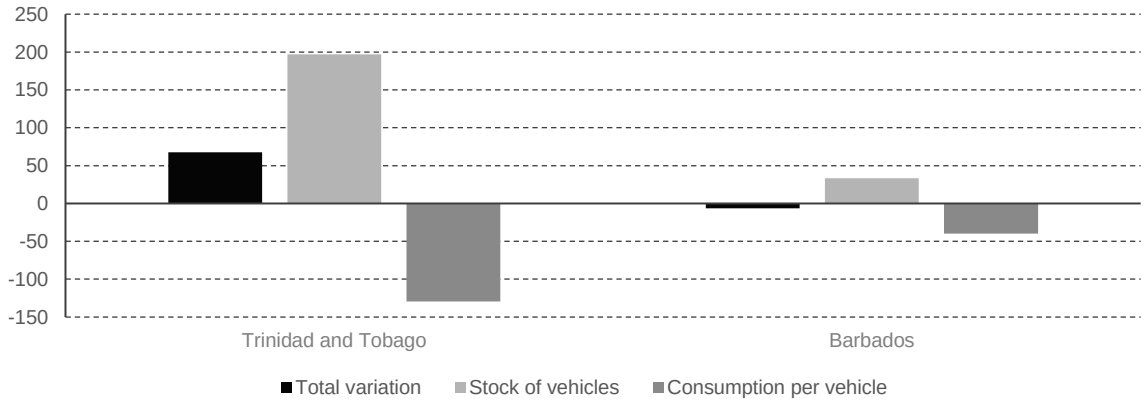
[21] For each type of vehicle, the stock is measured in terms of equivalent cars on the basis of their specific annual consumption compared to a car. If, for example, a bus consumes on average 15 toe / year and a car 1 toe / year, a bus will be equivalent to 15 cars. Due to a lack of national surveys, the following default values were based on data from ODYSSEE: 0.15 car equivalent for two-wheels, 1.4 for gasoline light vehicles, 2.6 for diesel light vehicles, 15 for a bus and a truck.

The variation of road consumption can be decomposed into two main effects:

- the increase in the stock of vehicles (activity effect)
- the variation of the unit consumption per vehicle (measuring the efficiency effect).

For Trinidad and Tobago, the increase in efficiency of road transport has been largely offset by the increase in the stock of vehicles, resulting in a 70 ktoe increase in road transport consumption between 2010 and 2015 (Figure 8).

Figure 38
Decomposition of road consumption variation (2010-2015)
(Ktoe)



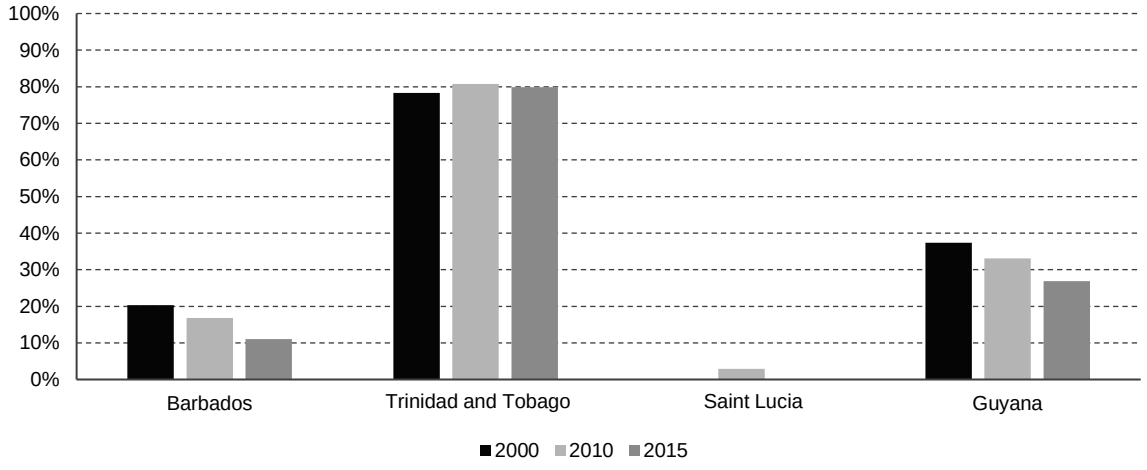
Source: BIEE, Cepal.

V. Energy efficiency trends in industry

A. Energy consumption patterns

The share of industry varies between 3% of final consumption (St Lucia) and 80% in Trinidad and Tobago where it is by far the largest energy consuming sector (Figure 39). In Barbados and Guyana the share of industry in final consumption is decreasing.

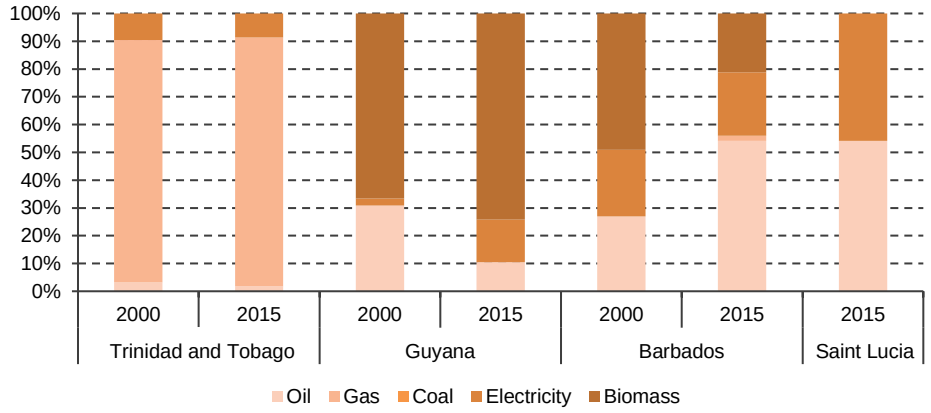
Figure 39
Share of industry in the final energy consumption
(Percentages)



Source: BIEE, Cepal.

Natural gas dominates the energy consumption of industry in Trinidad and Tobago (around 90%) (Figure 39). Biomass is important in Guyana (almost 75% in 2015). In Barbados and St Lucia, oil is the main source of energy (around 55%). In Barbados and St Lucia electricity is the second most important energy source (respectively 23 and 46%) while in Trinidad and Tobago electricity represents less than 10% of the consumption.

Figure 40
Energy consumption of industry by energy source
(Percentages)



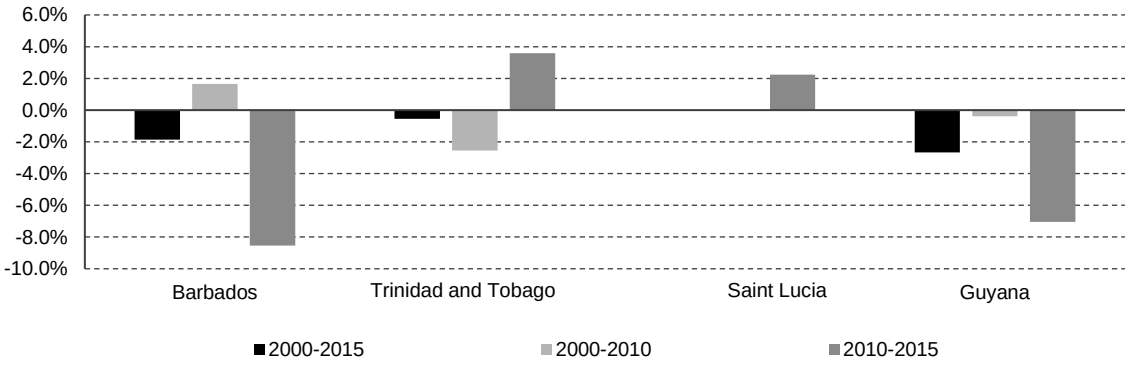
Source: BIEE, Cepal.

B. Energy intensity trends

The energy intensity of industry, calculated as the ratio between the energy consumption and the value added has decreased in most of the countries for the period 2000-2015, with a faster decrease for Barbados and Guyana since 2010 (Figure 41).

A reverse trend was observed for Trinidad and Tobago since 2010 with an increase in the energy intensity.

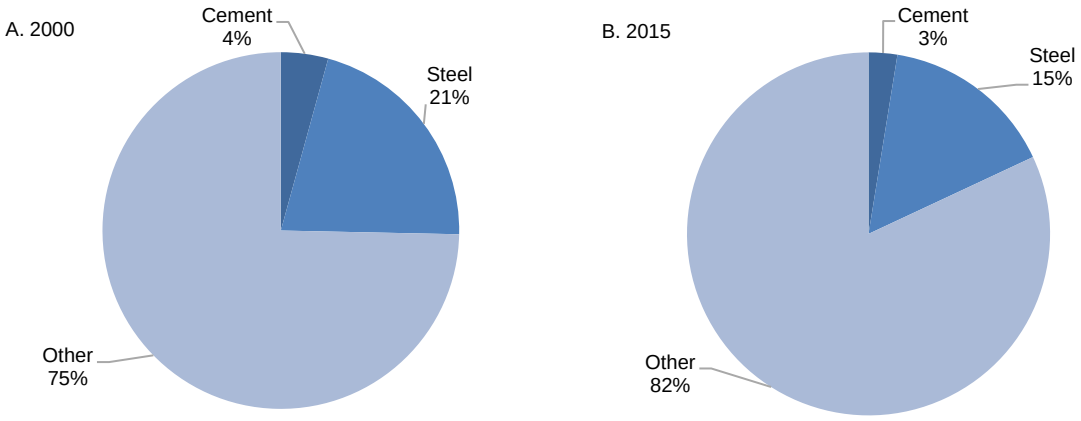
Figure 41
Energy intensity trends in industry
(Percentage/year)



Source: BIEE, Cepal.

Generally, few information is available on the breakdown of the energy use by industrial branch, especially in countries where this sector is marginal. In Trinidad and Tobago where industry represents a large share of the consumption this breakdown is only available for two branches (steel and cement) and for natural gas (Figure 42).

Figure 42
Gas consumption of manufacturing by sub-sector in Trinidad and Tobago
(Percentages)



Source: BIEE, Cepal.

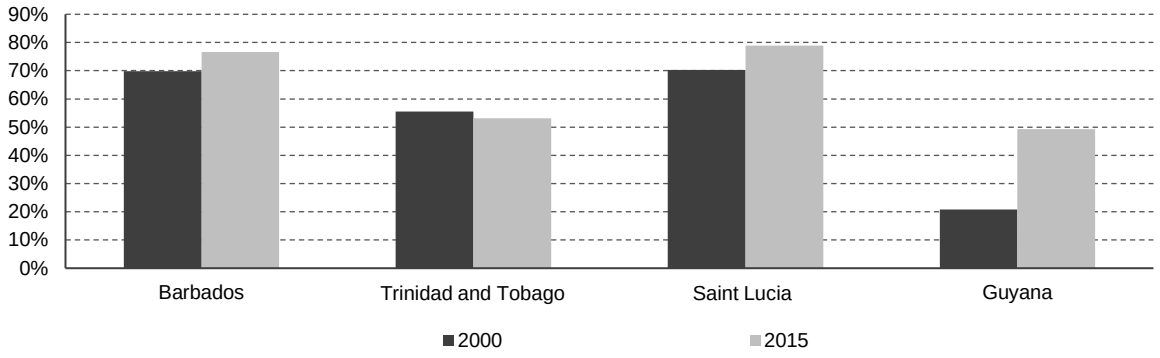
VI. Energy efficiency trends in services

A. Energy consumption patterns

The service sector, also called tertiary, is made of different activities, including wholesale and retail trade, tourism (hotels, restaurants), education, health, administrations (i.e. public sector), offices (financial institutions and other private services). Public lighting is also included in the consumption of this sector.

The share of services in the GDP varies between 20% in Guyana, 50% in Trinidad and Tobago and almost 80% in St Lucia and Barbados (Figure 43). The shift of the economy to more services has led to a growing share of services in the GDP, except in Trinidad and Tobago (stable share).

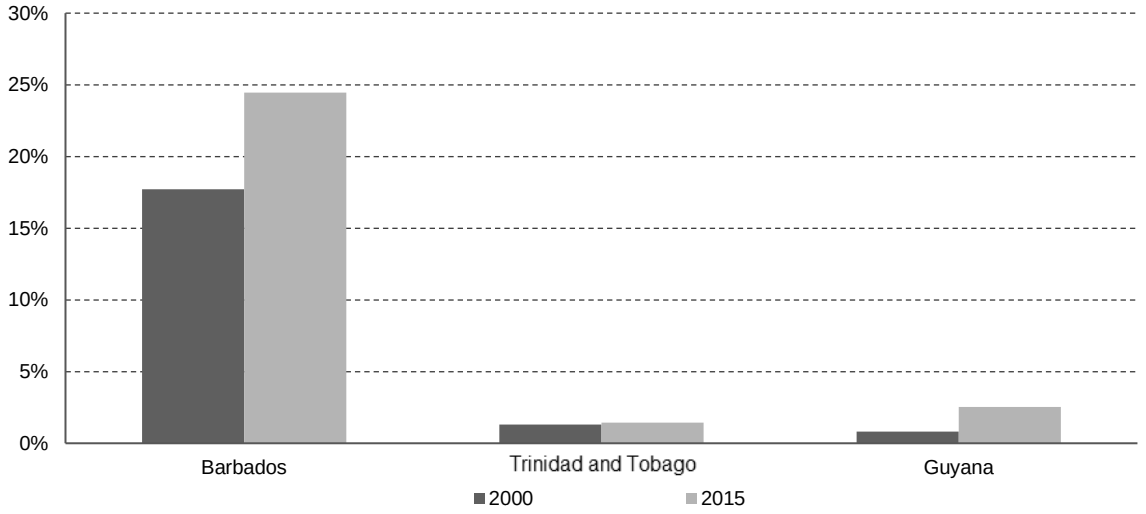
Figure 43
Share of services in the GDP
(Percentages)



Source BIEE, Cepal.

The share of services in the final energy consumption has been increasing since 2000 except in Trinidad and Tobago (Figure 44). The progression was especially rapid in Barbados (from 18 to 24%).

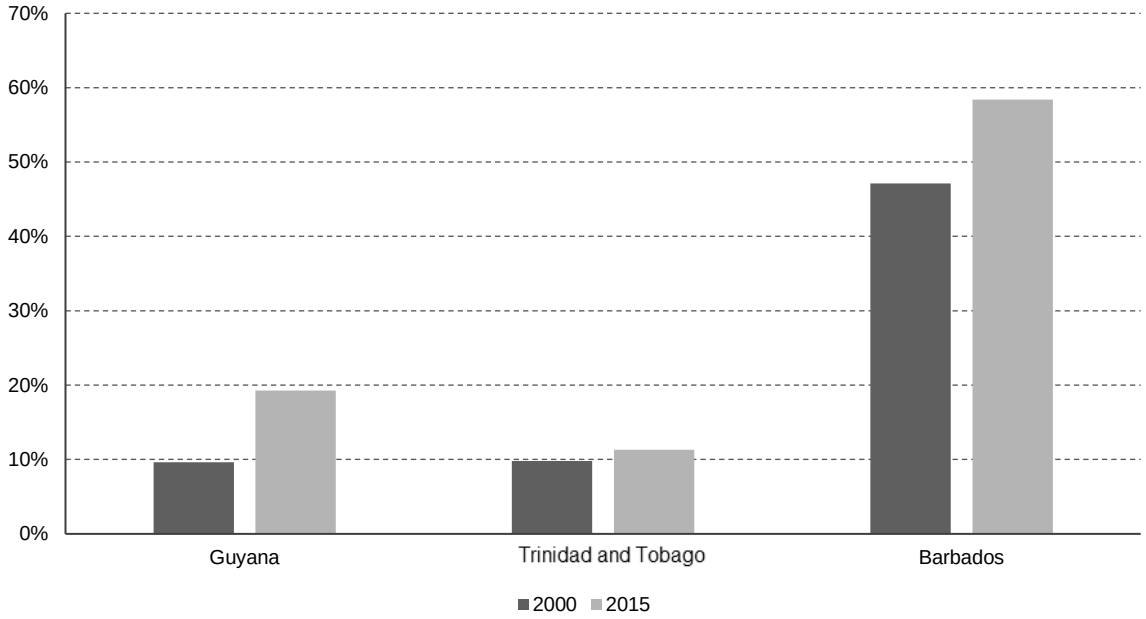
Figure 44
Share of services in the final energy consumption
(Percentages)



Source BIEE, Cepal.

The share of services in electricity consumption has increased by almost 10 points since 2000 in Guyana and Barbados. It is now close to 60% in Barbados (Figure 45).

Figure 45
Share of services in electricity consumption
(Percentages)

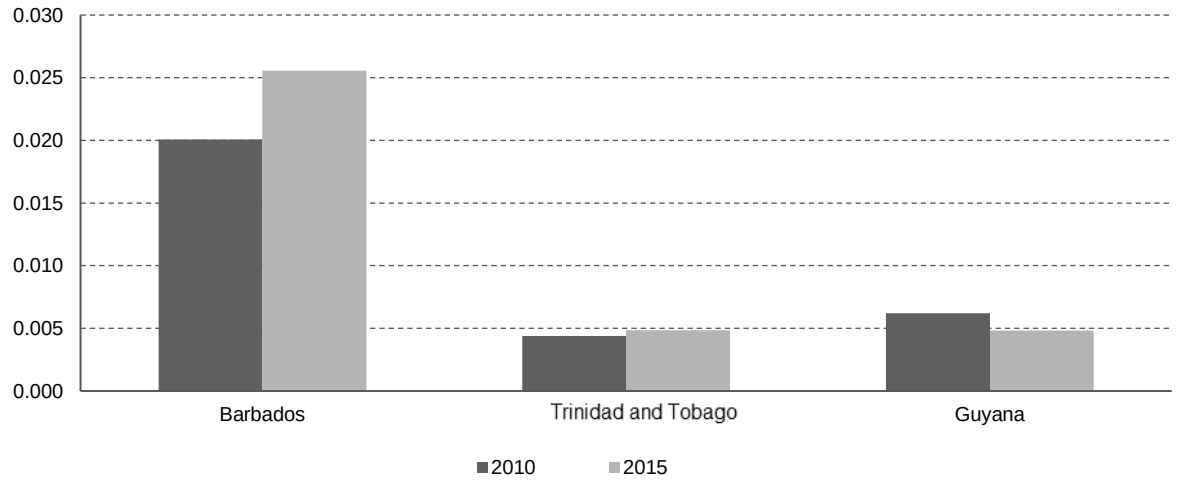


Source BIEE, Cepal.

B. Energy intensity trends

Since 2000, the energy intensity of services, defined as the ratio energy consumption over value added, has decreased in Guyana and has remained constant in Trinidad and Tobago. Barbados has the highest intensity in services, partly because the importance of tourism. In Barbados, this intensity has increased significantly since 2010, implying that energy consumption grew faster than the economic activity (Figure 46).

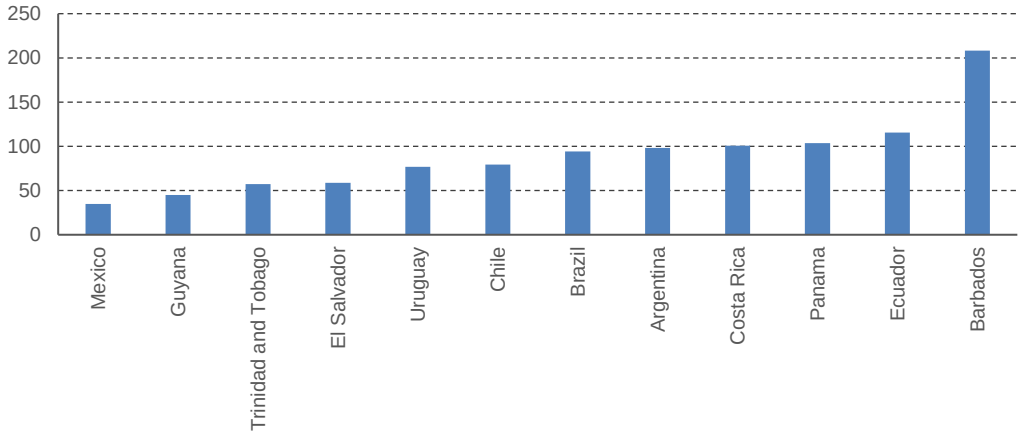
Figure 46
Energy intensity of services
(Koe/$00p)



Source: BIEE, Cepal.

If we focus on electricity, which represents the bulk of the energy consumption in services, and if we enlarge the sample of countries, Barbados remain still the country with the highest electricity intensity (Figure 47).

Figure 47
Electricity intensity of services in selected countries
(MWh/$2000p)

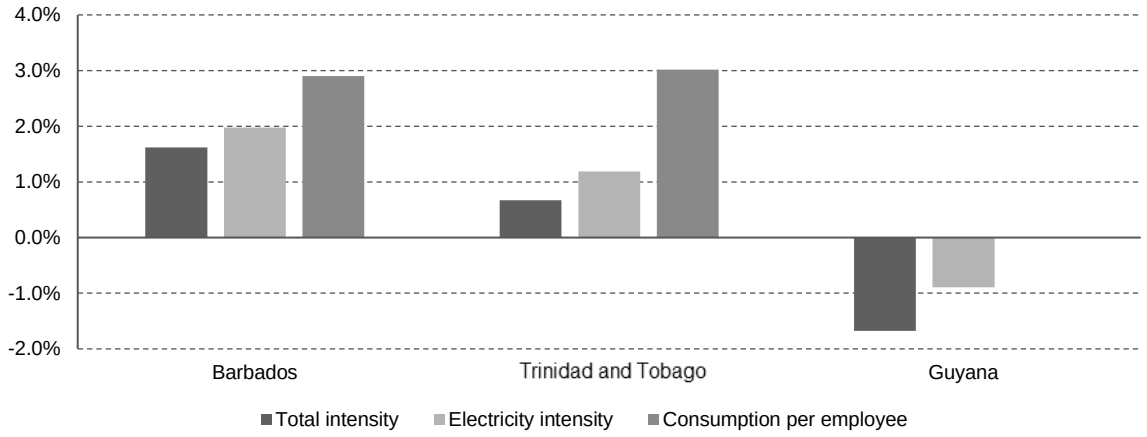


Source: BIEE, Cepal.

The trends in energy intensity of services vary significantly across countries with a decrease in Guyana (-1.7%/year) and a progression of 1.6%/year in Barbados for total consumption (Figure 48). The electricity intensity increased more rapidly than the total intensity for Barbados and Trinidad and Tobago, reflecting a higher growth of electricity uses, such as ICTs and air conditioning.

The average energy consumption per employee increases more rapidly than the final intensity (by around 3%/year for Barbados and Trinidad and Tobago).

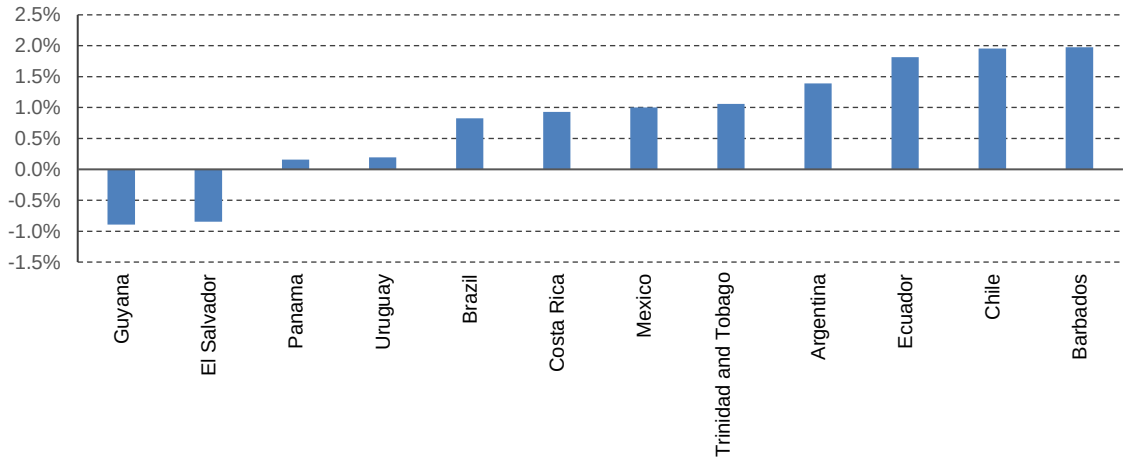
Figure 48
Trends in energy intensity and unit consumption per employee of services (2000-2015)
(Percentage/year)



Source: BIEE, Cepal.

Changes in intensities are very different according to countries: strong increase in Barbados and Chile (around 2%/year), slow growth in Panama and Uruguay, and a reduction in Guyana and El Salvador (Figure 49).

Figure 49
Trends in electricity intensity of services (2000-2015)
(Percentages)

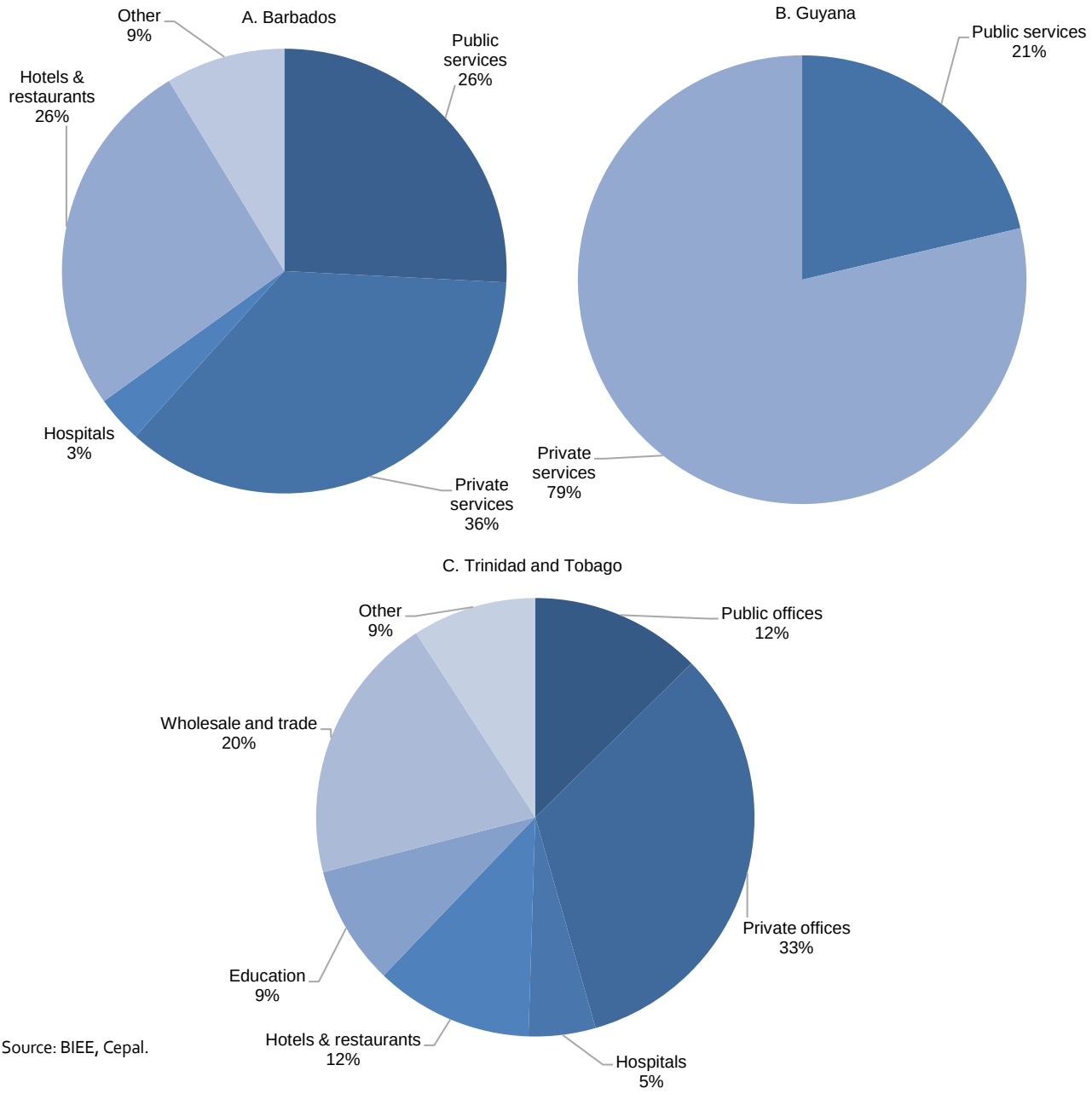


Source: BIEE, Cepal.

C. Consumption by branch and for public lighting

Hotels and private offices represent around 50% of the electricity consumption of services in Barbados and Trinidad and Tobago (Figure 50).

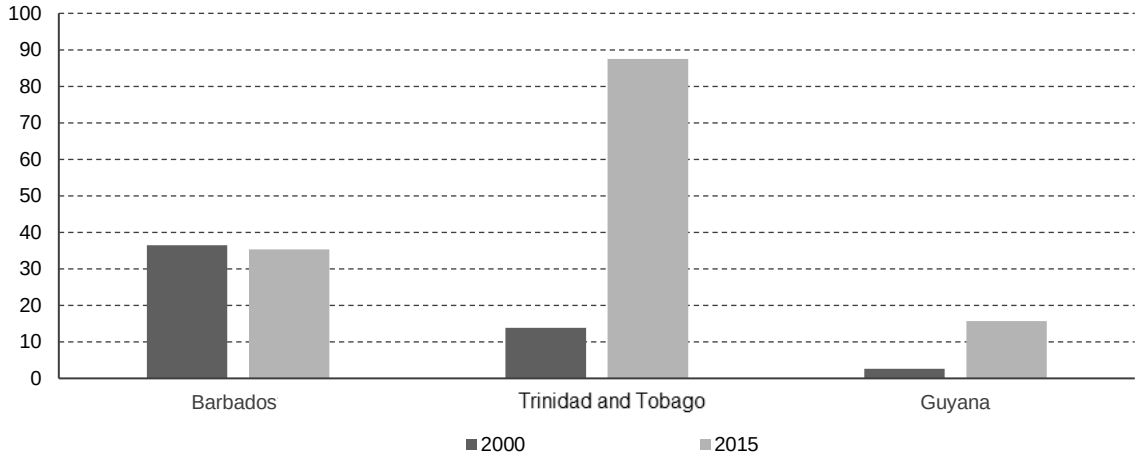
Figure 50
Electricity consumption by branch (2015)
(Percentages)



Source: BIEE, Cepal.

The electricity consumption for public lighting per capita has been increasing in Guyana and Trinidad and Tobago due to the spread of the public lighting network. The highest level is observed in Trinidad and Tobago: around 90 kWh/capita (Figure 51).

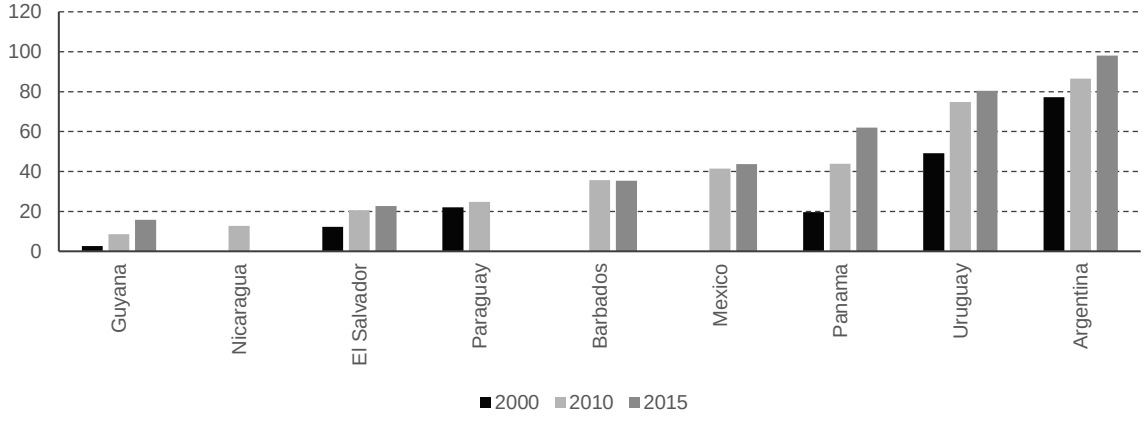
Figure 51
Electricity consumption for public lighting per capita
(Percentages)



Source: BIEE, Cepal.

If we enlarge the sample of countries, there exist large disparities in the electricity consumption for public lighting per capita. This consumption has increased everywhere despite the policies implemented, mainly because of the extension of the public lighting services (Figure 52). Trinidad and Tobago remains among the countries with a high consumption level.

Figure 52
Electricity consumption for public lighting per capita in selected countries
(KWh/cap)

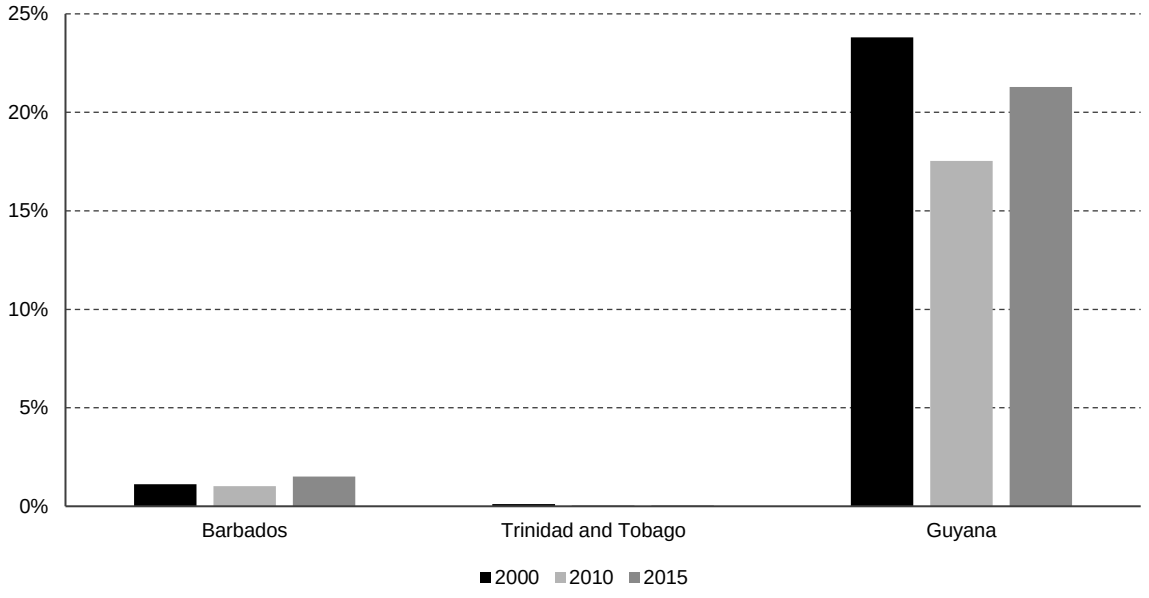


Source: BIEE, Cepal.

VII. Energy efficiency in agriculture

The share of agriculture, fisheries and forests in the final energy consumption is usually less than 5% in most Latin American countries: this is the case of Barbados and Trinidad and Tobago. In Guyana, this share is much higher (around 20%) (Figure 53).

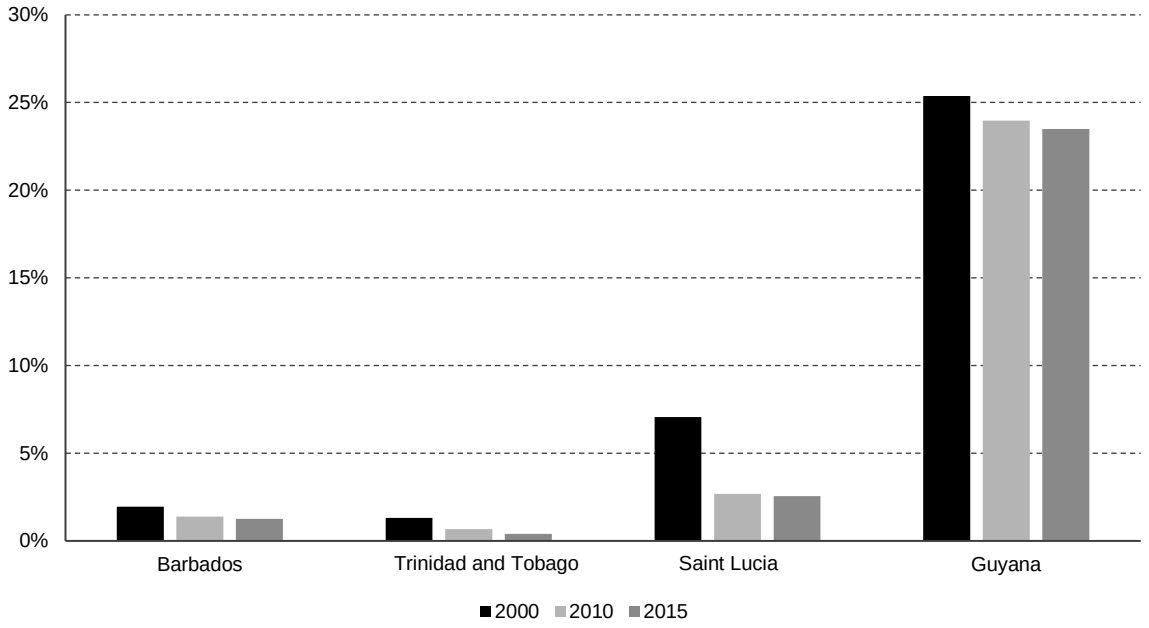
Figure 53
Share of agriculture, fishing and forestry in final energy consumption
(Percentages)



Source: BIEE, Cepal.

The value added of the sector is quite significant for the economy in Guyana, with a share of the value added of the sector in the GDP around 20% (Figure 54). In all countries this share of is decreasing.

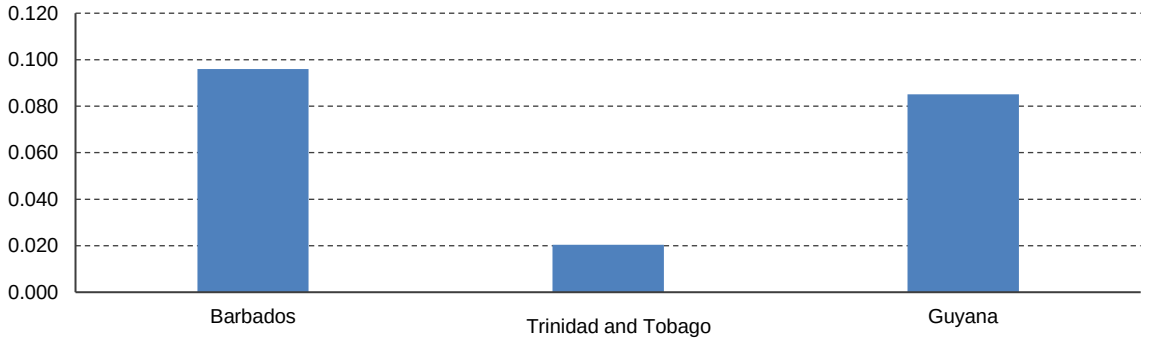
Figure 54
Share of value added of agriculture, fishing and forestry in GDP
(Percentages)



Source: BIEE, Cepal.

The energy intensity of agriculture is usually high in the countries with high share of agriculture in the GDP (case of Guyana with around 0,09 koe/$2000p) but is also the case of Barbados where the share of agriculture in the GDP is only 2% (Figure 55).

Figure 55
Energy intensity of agriculture
(Koe/$oop)



Source: BIEE, Cepal.

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Annex

Annex 1
Organization of the BIEE project on energy efficiency indicators

The BIEE project on energy efficiency indicators in Caribbean countries was organised in three main activities:

- training of experts from national energy Ministries.
- data collection.
- dissemination of data and indicators in a regional database on energy efficiency indicators by sector, with national databases and reports on energy efficiency trends by country.

Training

Training of an average of two experts by country was a first step, with usually one representative of the Ministry in charge of energy and one consultant. Training materials adapted to the Caribbean context were produced by the technical coordinator (Enerdata) and illustrated with example from other Latin American countries.

Three trainings have been organized, with a presentation of the main energy efficiency indicators by sector. The training was designed for experts that had little knowledge of energy efficiency indicators. The presentations were organized by sector presenting key performance indicators which can be relevant for the Caribbean countries, with emphasis on definitions and concepts and illustration through several case studies.

The trainings also enabled the teams to strengthen their capacity, analysis and interpretation of indicator trends. In particular, countries' representatives were asked to prepare several presentations based on the results for their countries with the assistance of the technical coordination for reviewing.

Finally, assistance was provided by the technical coordination for the preparation of the national reports by providing a very detailed template.

Data collection

The collection of data required for the calculation of indicators began with the creation of an Excel template. This template was adapted from the BIEE data template used for other Latin American countries. The main adaptations done were to simplify the previous template and to add bauxite mining, as it is significant in Guyana. The data template is organised in 7 main sheets corresponding each to a sector: macro (for general macro-economic and energy balance data), energy, industry, households, services, transport and agriculture.

Each data sheet has the same structure:

- Column 1: Identification code of the data series.
- Column 2: Title in English.
- Column 3: Title in Spanish-
- Column 3: Country code (in 3 letters; e.g. arg for Argentina).
- Colum 4: Unit.
- Columns 5 to n: Annual values (one column per year).
- Colum n+1: Source (short source to characterize each data series).

- Colum n+2: Note (used to detail the source).

All the indicators are directly calculated in the Excel template to allow users to understand their calculations. Predefined graphs are available at the end of each sheet to check trends and detect possible data disruptions.

Energy Ministries and consultants have been guided throughout the project to fill in this file, backed by the technical coordination of the project (Enerdata, ECLAC and ADEME), to help them adapt existing data sources to the template categories.

Dissemination

An interactive database has been developed to present the main indicators and is available at: http://biee-cepal-database.enerdata.eu/datamapper-caraibes/.

High energy costs and fossil fuel dependancy contribute to dampening Caribbean competitiveness and potential growth. In this scenario, energy efficiency has the potential to reduce energy consumtion, ensure an adequate supply of energy, increase energy security, reduce negative environmental impacts and, at the global level, reduce emissions of greenhouse gases (GHGs). However, it is important to have a clear understanding of macro energy sector conditions before implementing energy efficiency policies. In this study, we describe and compare energy efficiency trends in four countries in the Caribbean subregion: Barbados, Guyana, Saint Lucia and Trinidad and Tobago. The report is based on data and indicators prepared for the Energy Efficiency Indicator Database (BIEE) project, carried out by the Natural Resources Division of the Economic Commission for Latin America and the Caribbean (ECLAC) under the umbrella of the Regional Observatory on Sustainable Energies, and in close cooperation with the French Environment and Energy Management Agency (ADEME).

ECLAC

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