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Overview of energy efficiency trends by sector

Dr Didier Bosseboeuf, ADEME
Dr Bruno Lapillonne, Laura Sudries Enerdata

Goal 7 on energy

- Among the sustainable goals, **Goal 7** addresses **energy** and aims at “ensuring access to affordable, reliable, sustainable and modern energy for all” with three quantified targets.
- **Goal 7.3** addresses **energy efficiency**.
- It states to “**double the rate of improvement in energy efficiency by 2030**”.
- The monitoring of this goal is presently done by UN with the “global energy intensity”, which corresponds to the “primary (or **total**) energy intensity”.
- However, the question of **how to measure** energy efficiency improvement is a complex question without simple answers: it is the core of dedicated projects such as **BIEE** in LACs or **ODYSSEE** for EU countries .
- In this presentation we will review a selection of energy efficiency indicators; more indicators can be found in the report (over 50).

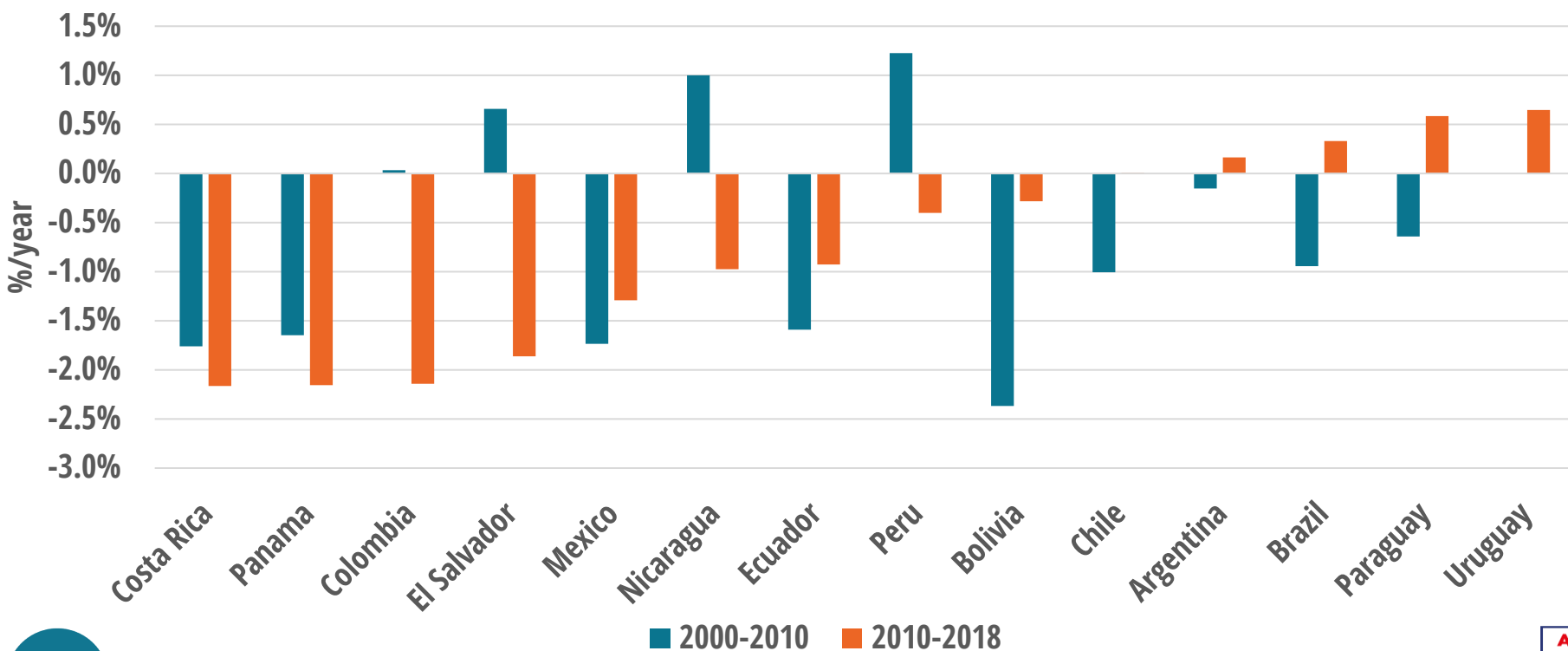
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Overall energy intensity trends

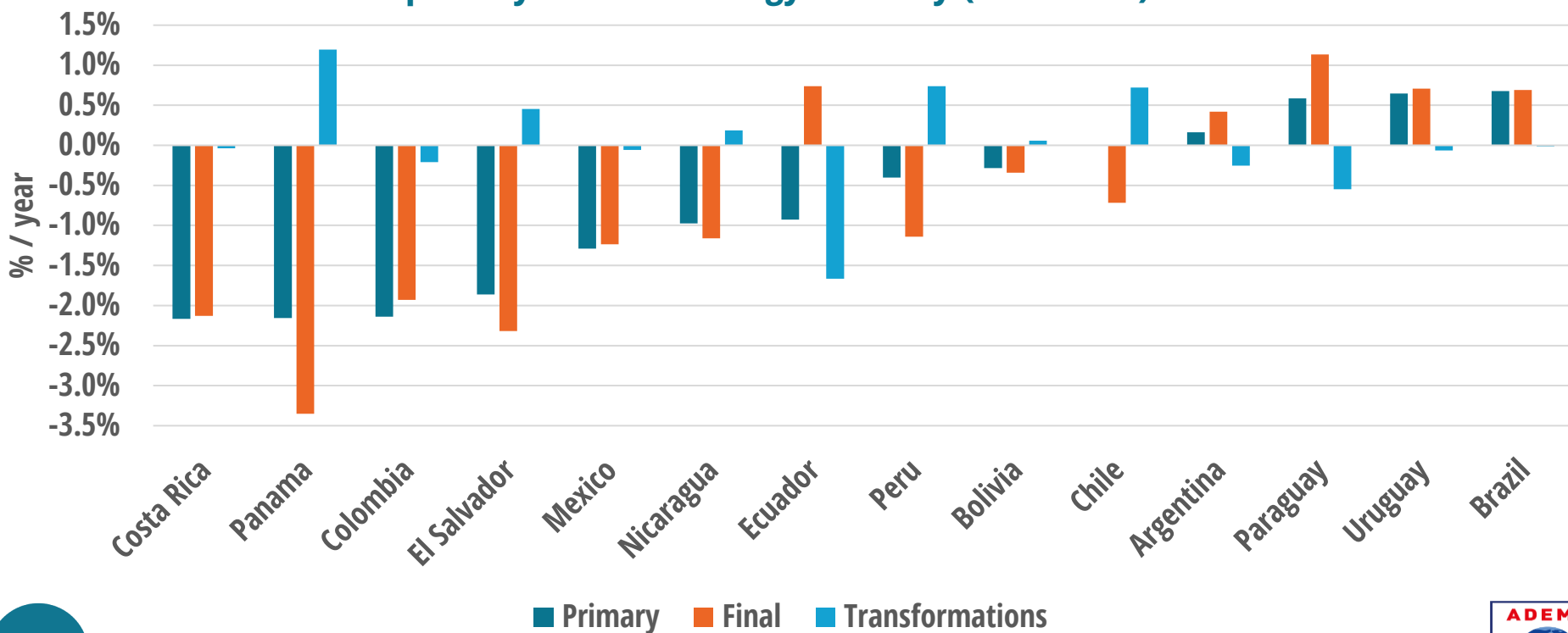
- If energy efficiency progress is measured with the **primary energy intensity**, as the SDG7 goal, **8 countries** have improved their efficiency significantly since 2010 (Ecuador, Mexico, Costa Rica, Panama, Colombia, El Salvador, Peru and Nicaragua), with for the **6** later an **increasing rate of “EE improvement”**, as stated in SDG7,3 goal, and even for the 3 later a **reversing** of the increasing trend observed before 2010.
- However, **6 LACs** are **not in line** with SDG7.3 goal, with even **4 countries** with an increasing trend.

Primary energy intensity trends



- Trends in primary intensity are influenced by changes in energy transformations, and mainly in the power mix, which is not really energy efficiency.
- Trends in **final energy intensity** are **more relevant** to measure energy efficiency, as most energy efficiency measures target final consumers.
- Since 2010, the final intensity decreased faster than primary intensity in 4 countries : very significantly in Peru and Panama (+ El Salvador and Nicaragua); this is due **to increasing losses** in energy transformations which have offset part of the progress at final level.

Trends in primary and final energy intensity (2010-2018)



Energy intensity and energy efficiency

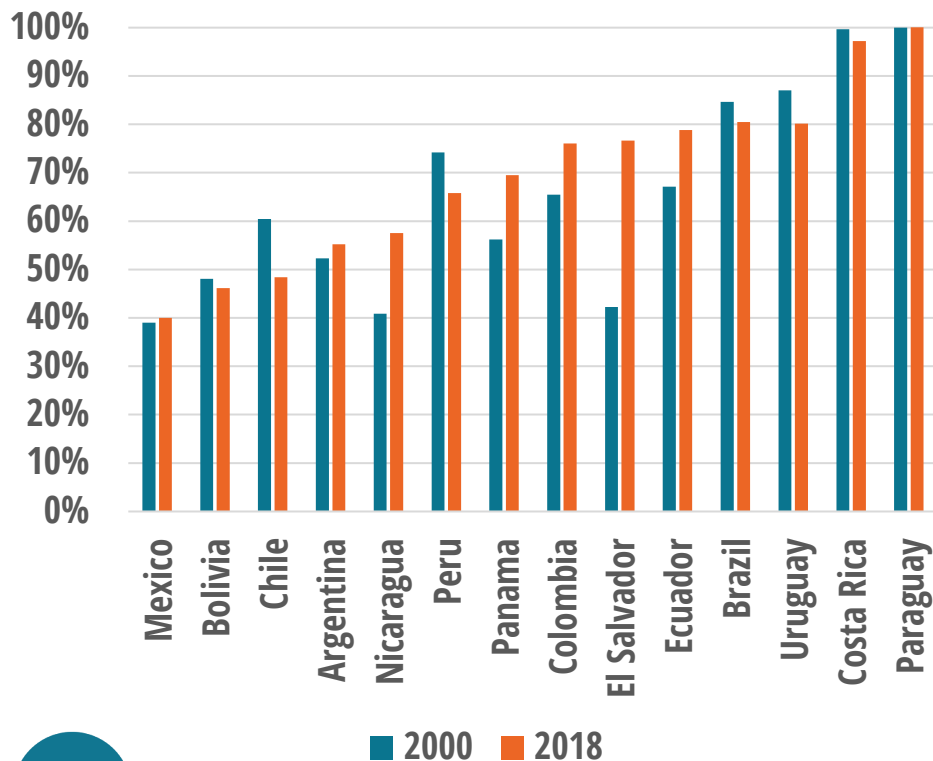
- The total energy intensity indicates how much energy is consumed to produce one unit of GDP : a **decrease** indicates that less energy is required but it may not be the result of **energy efficiency** improvements **only**.
- The **final energy intensity** would be a **better** indicator as it not affected by changes in supply, in particular in the power mix, but it will be still influenced by other factors not linked to energy efficiency (e.g. “structural changes”).
- Trends in total or final energy intensities provide an **economic** assessment of energy consumption but **do not tell anything about the factors behind this trend, in particular energy efficiency**.
- To better understand what is going on and better measure the impacts of energy efficiency programmes **more detailed indicators** are required, such as the indicators developed by sector in the framework of **BIEE**.

Power sector

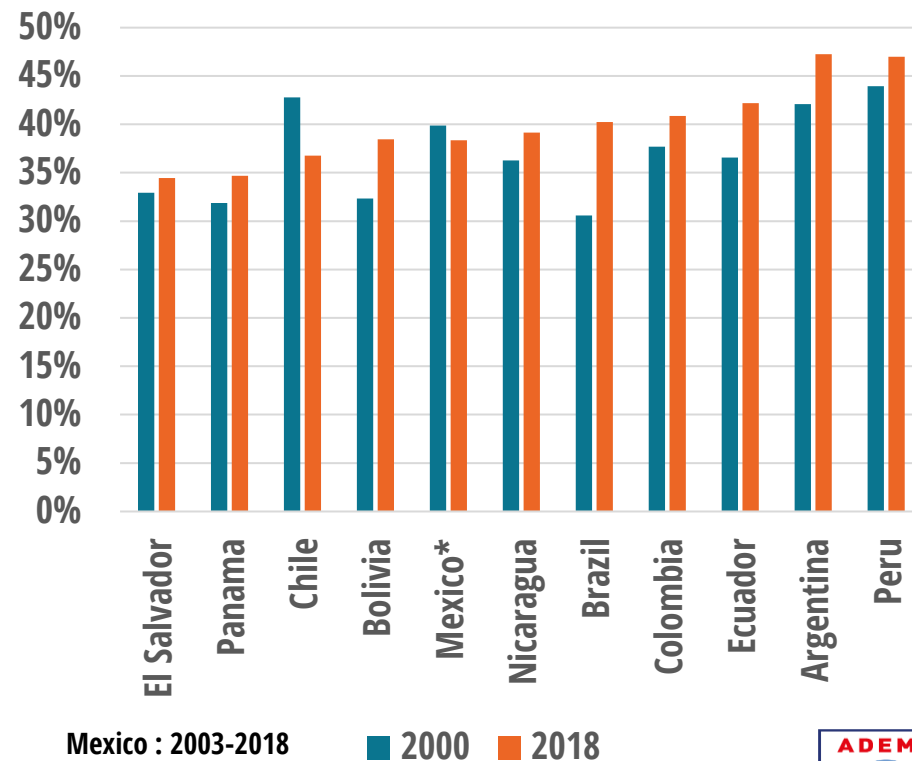
Thermal power and overall generation efficiency

- The efficiency of thermal power plants varies from 47% in Argentina and Peru (high share of gas CCGT) to 35% in Panama, El Salvador, and Chile because of coal.
- It has **improved the most** in Peru and Bolivia, (shift to gas CCGT), but has **decreased** significantly in Chile, El Salvador, and Panama (use of coal).
- Countries with a high share of renewables have the **highest overall** power efficiency (e.g. Paraguay and Costa Rica).

Efficiency of power generation



Efficiency of thermal power generation

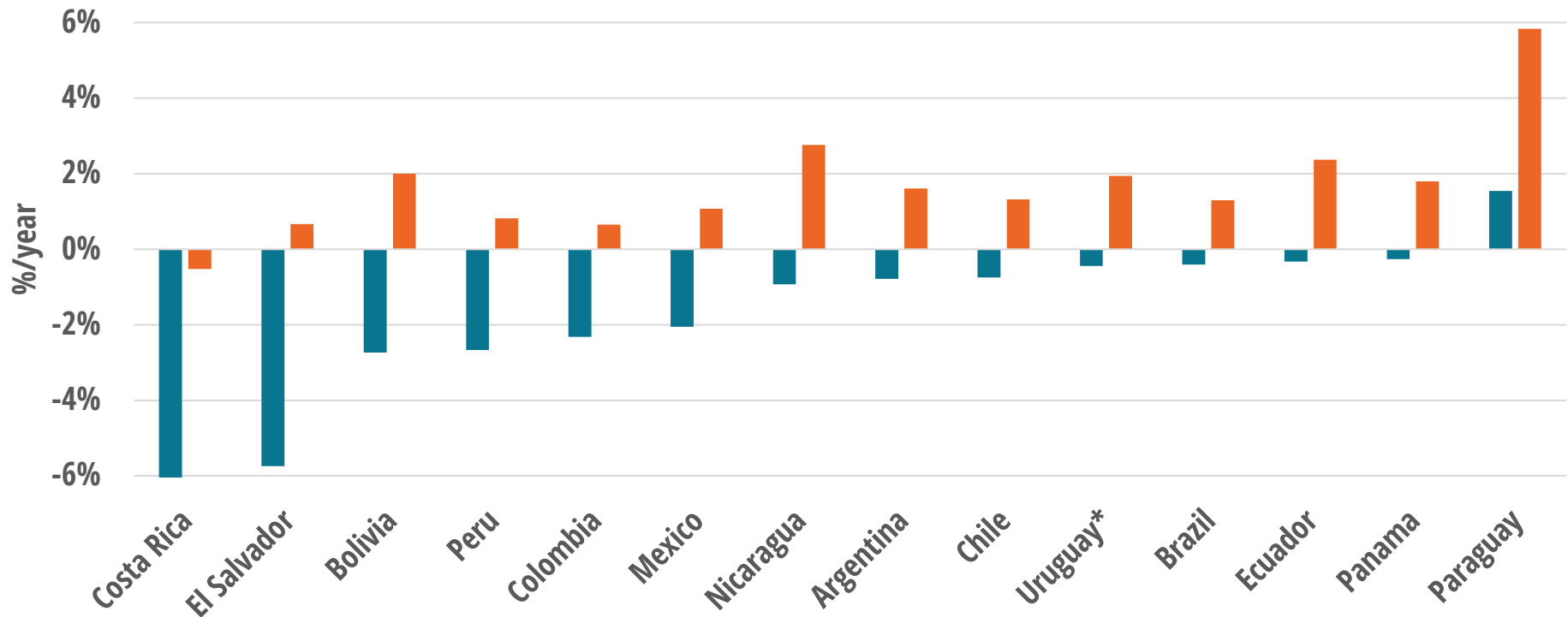


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Households

- **Opposite trends** for total and electricity consumption for household
- The average consumption per household has been decreasing in almost all LACs mainly because of the substitution of biomass by clean fuels for cooking.
- The electricity consumption per household has increased significantly in Paraguay (~6%/yr) and to a lesser extent in other countries (1-3%/yr) with the growth in equipment rate (refrigerators, TV, ICT, AC, water heater) and electrification. In Costa Rica, the decrease may be linked to EE measures for appliances and lighting.

Variation of total and electricity unit consumption of households (2010-2018)



*Uruguay : 2006-2018

■ Total ■ Electricity

Source: BIEE <https://biee-cepal.enerdata.net>

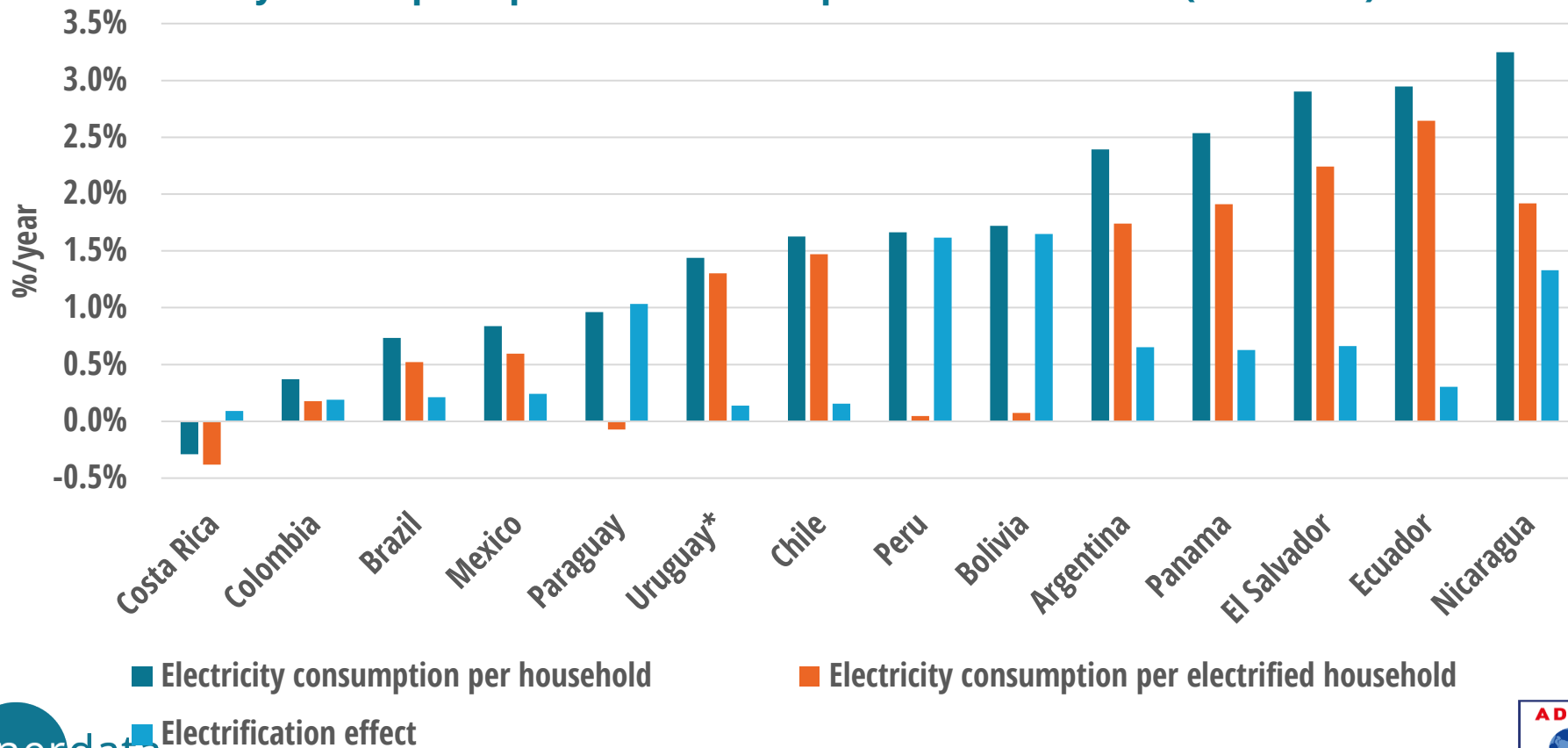
Interpretation of trends in EEI by sector combining different indicators

- The interpretation of EEI trends is much enriched by comparing the trends in **two** different indicators:
 - The observed one
 - And a second indicator that is cleaned from the variation of a factor.

| End-use | Indicators to be compared | Interpretation of differences |
|-------------|---|-------------------------------|
| Cooking | toe/household in useful and final energy | Effect of change in fuel mix |
| Electricity | kWh per household and kWh per electrified household | Effect of electrification |

- In Peru, Bolivia and Paraguay, most of the increase in the electricity consumption per household is due to the electrification of rural households: the consumption per electrified household has almost not changed.
- In Nicaragua, the household's electrification explain 1/3 of the increase in the consumption per electrified household.

Unit electricity consumption per household : impact of electrification (2000-2018)



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Transport

Interpretation of trends: combination of EEI by sub-sector: transport sector

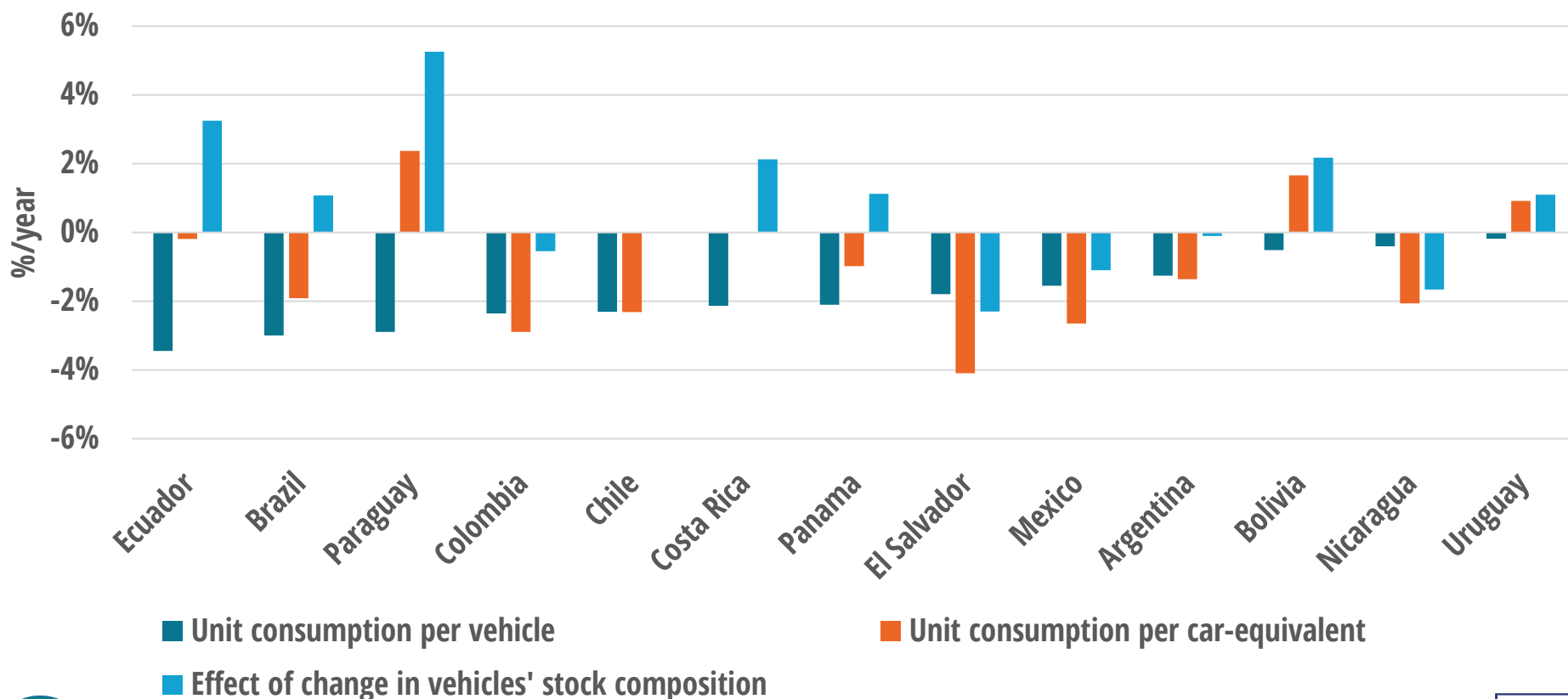
- For road transport we can indicator a specific energy consumption of road transport per vehicle.
- Such an indicator is generally decreasing, due to the increased efficiency of vehicles , but also and to the shift to smaller vehicles in the total stock (higher share of cars or even motorcycles) .A better aggregate indicator is the specific consumption of road transport per equivalent car, which relates the total consumption of road transport to a fictitious stock of vehicles, measured in terms of number of equivalent cars*.

| End-use | Indicators to be compared | Interpretation of differences |
|----------------|--|---|
| Road transport | Consumption per vehicle and consumption per equivalent car | Effect of change in the mix of road vehicles between light and heavy vehicles |

**For instance, if a motorcycle consumes 0.2 toe/year on average and a car 1 toe/year, one motorcycle is considered to be equivalent to 0.2 cars. If buses consume 10 toe/year , they are equivalent to 10 cars.*

- In all countries, the unit consumption per vehicle (blue bar) is decreasing, often thanks to changes in vehicles' stock composition, especially in Paraguay and Ecuador.
- Decreasing trends in the unit consumption per equivalent (orange bar) car reflect mainly improvements in energy efficiency of all vehicles.

Trends in road transport consumption (2000-2018)

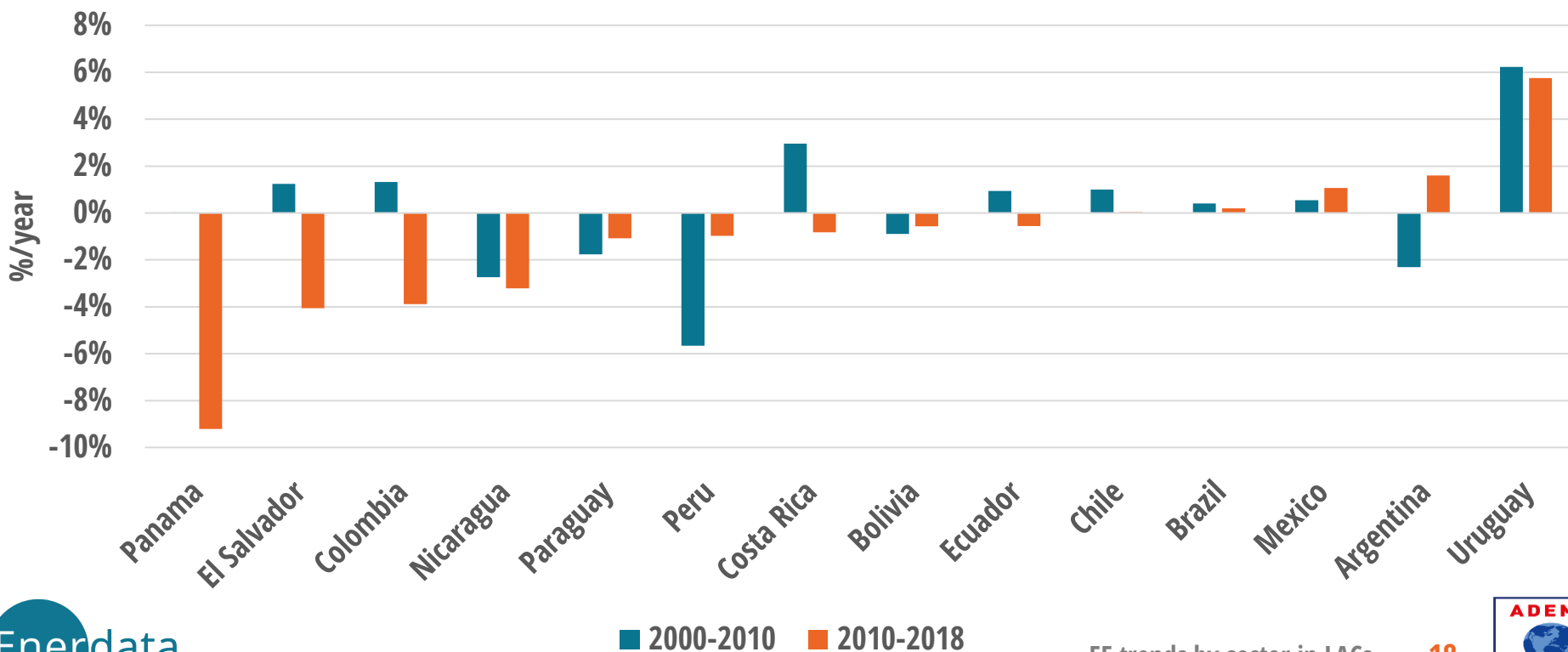


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Industry

- Decreasing energy intensities are observed in most countries, reflecting a growing share of less intensive industrial branches.
- Uruguay is an exception with a sharp increase in the energy intensity, following the commissioning of a large paper mill combined to a chemical plant (2008).
- Argentina, Mexico, and Brazil also have a more intensive industry structure.
- Part of these variations may be due to structural changes in industry (see **Annex 1**)

Trends in industry intensity



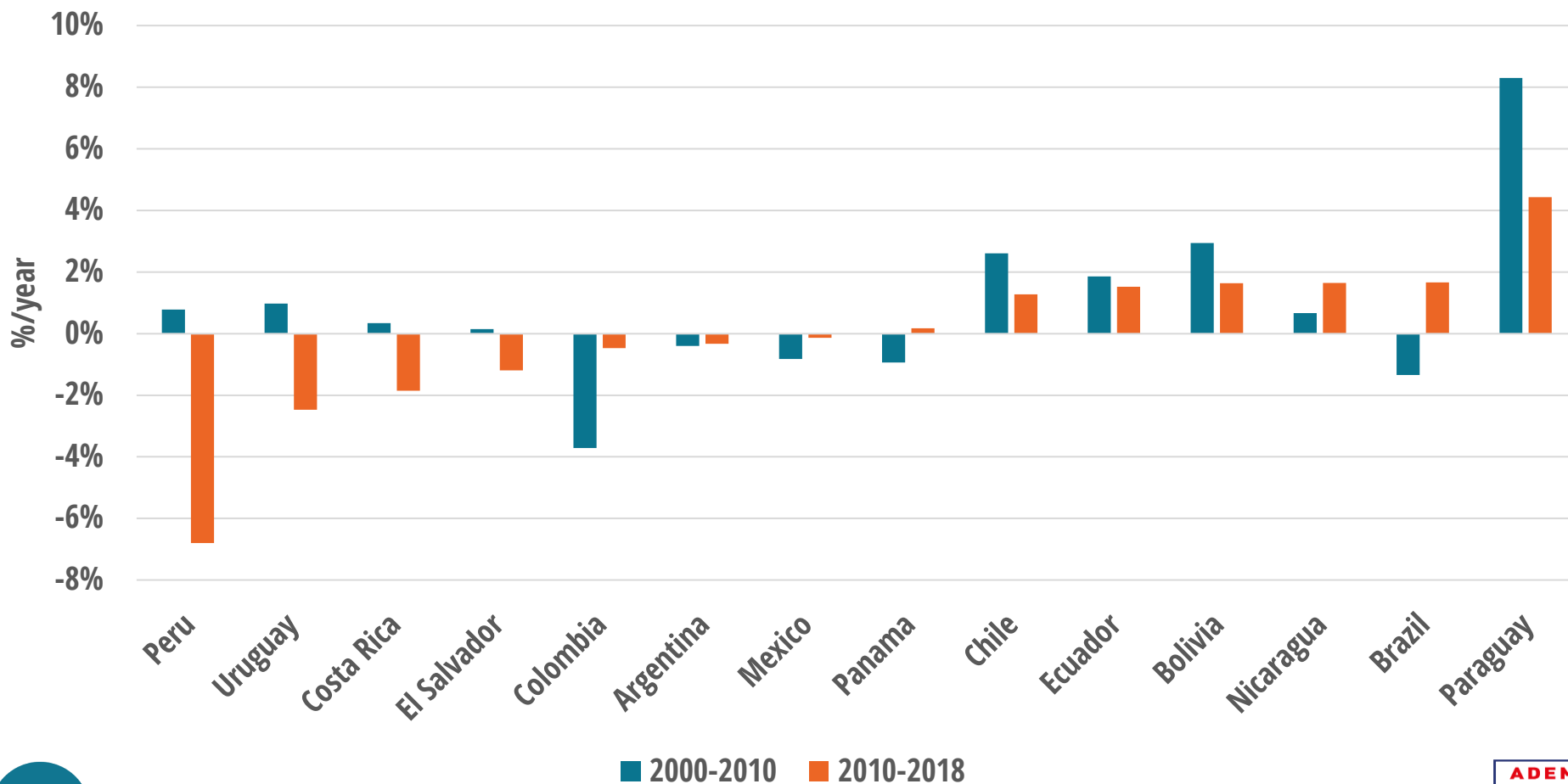
Source: BIEE <https://biee-cepal.enerdata.net>

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Services

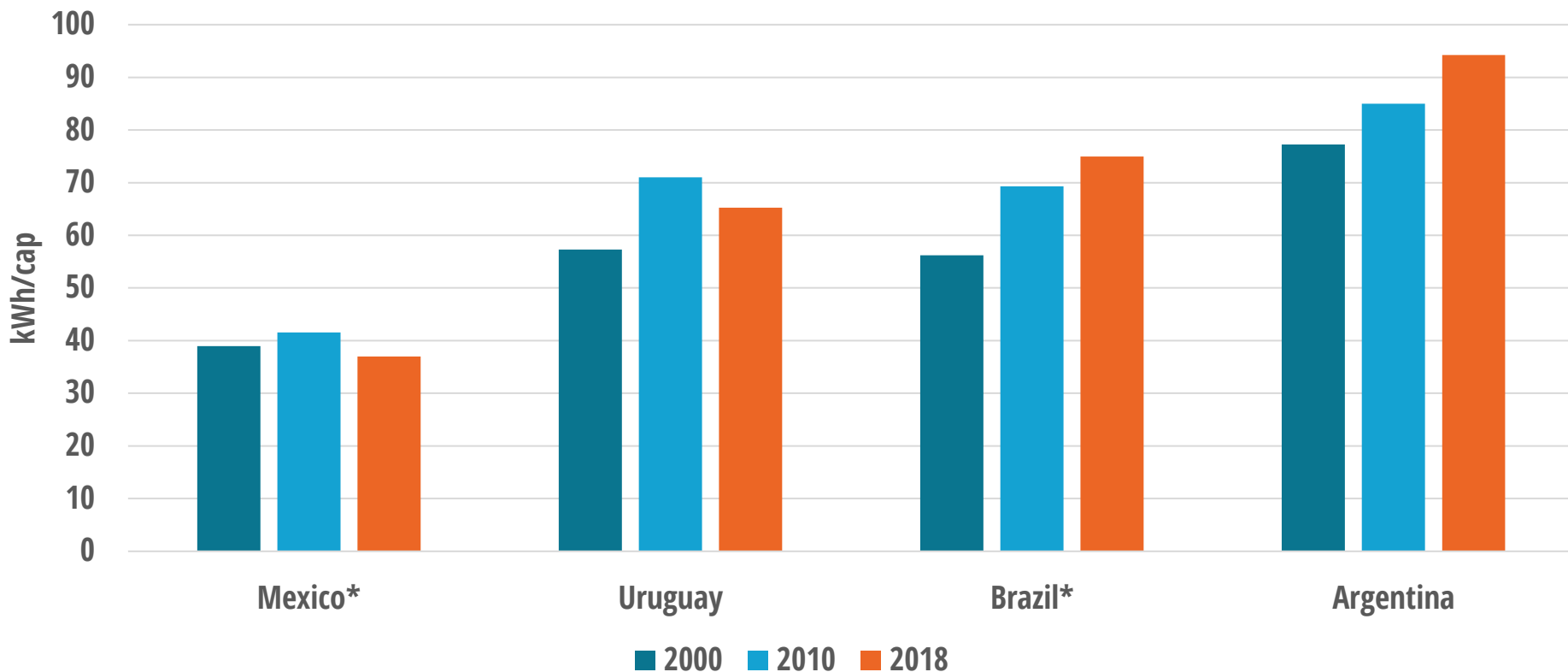
- The trends in energy intensity of services vary significantly across LAC countries from around -6.8%/year in Peru to +4.4%/year in Paraguay.

Trends in services intensity



- Since 2010, the electricity consumption for public lighting per capita has started decreasing in Mexico and Uruguay and is progressing slower in Brazil, probably as a result of national energy savings policies.
- It is still increasing in Argentina.

Electricity consumption for public lighting per capita



*Mexico : 2002-2018 *Brazil : 2004-2018

Source: BIEE <https://biee-cepal.enerdata.net>

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Conclusion

From simple energy efficiency indicators to advanced indicators

- Usual energy efficiency indicators are useful to describe trends, but cannot **explain** the observed trends.
- For instance the energy consumption per household shows how the overall energy efficiency of households is changing but a **decrease does not necessary mean** that energy efficiency is improving from a technical viewpoint.
- These indicators need more **disaggregate data**: by household end-use, by mode of transport, by industrial branch....
- Such data are still limited in the majority of LACs: they are well monitored in Brazil, Mexico and Uruguay.
- All results have been published by Cepal in 2 **synthesis reports**, in English and Spanish.