ENERGY TRANSFORMATION

LATIN AMERICA AND THE CARIBBEAN

Regional analysis extends from the Caribbean Islands and Central America to the southernmost tip of South America.

STATUS/CHARACTERISTICS AND NEEDS:

Population (millions)

Current:	**6.1% of global population.** Highest regional share in Brazil (40%) followed by Colombia (10%) and Argentina (9%).
2050 outlook:	Average **0.4% per year increase** to **536 million**, or 5.7% of global population.

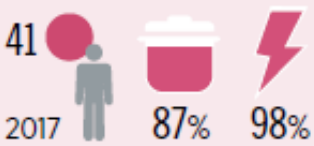
IRENA analysis based on E3ME.

GDP per capita (thousand USD 2015)

Current:	**Below the global average** (10.9).
2050 outlook:	**Swift development;** ▶ **PES:** CAGR = 3.8%

IRENA analysis based on E3ME.

Energy consumption (GJ/capita) and **energy access** (%)



Energy consumption per capita:

Current: below global average (51 GJ/year).

2050 outlook:
▶ **PES:** high increase to 56 GJ/year.

Electricity access:

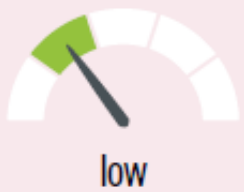
Almost complete except for few countries such as Honduras and Haiti.

Clean cooking access:

13% of region's population lack access; major concern in some countries.

Source: Access to electricity, 2017 values (World Bank Group, 2019a), access to clean cooking, 2016 values (World Bank Group, 2019b), TFEC, 2017 values (IEA, 2019).

Fossil fuel net import



Current status: **Comparatively energy self-sufficiency region-wide;** Central America imports fossil fuels, while Andean and Southern Cone sub-regions are net exporters.

2050 outlook: **Resource diversification; enormous untapped potential.**
▶ **PES:** The total generation (est. 3138 TWh) just represents **6%** of overall renewable power potential.

Note: Current status, IRENA analysis based on proportion of net imports of fossil fuels in TPES, 2017 values (IEA, 2019). 2050 outlook, IRENA analysis and potential based on Deng *et al.* (2015).

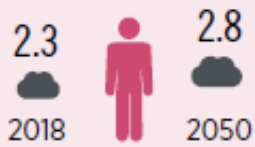
Energy-intensive industries (% in global consumption)

Current status: Accounts for **17%** of the world's energy demand for **food and tobacco** and **over 10%** of global energy consumption in the **paper industry**.

2050 outlook: Require significant **efforts and specific solutions to decarbonise** energy-intensive industries.

Note: Current status, IRENA analysis based on 2017 values (IEA, 2019).

Energy-related CO_2 emissions per capita (tCO_2/capita)



Recent: **Region's annual emissions: 1.2 Gt** (2018). 4% of global energy-related CO_2 emissions.

2050 outlook: ▶ **PES: 39% increase to 1.7 Gt** with enabling policies.

Note: 2050 values based on IRENA analysis and historical data based on Global Carbon Atlas (2019).

Urban air quality (%)

Rising transport emissions with continued population growth and urbanisation.

Current plans would boost light-vehicle sales, but also intensify traffic jams and local pollution.

IRENA analysis based on PM 2.5 concentration, 2016 and 2017 values (WHO, 2019).

Electricity prices and renewables costs

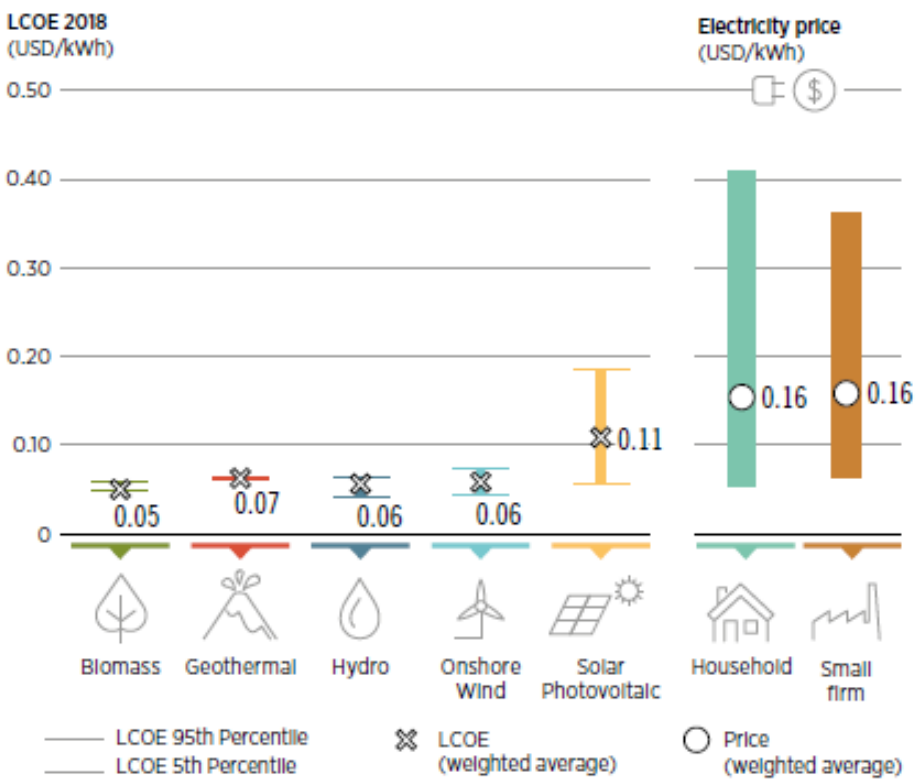
Electricity price:

Mid-range (for households and industries) compared to other regions.

Renewables cost and auctions:

Cost-competitive; Argentina attained wind price at an average of USD 0.041/kWh in 2017; Brazil attained solar price at an average of USD 0.021/kWh in 2019 (IRENA, 2019a). Hydropower projects remain highly competitive.

Latin America and the Caribbean



Source: LCOE based on IRENA (2019b) and electricity prices based on Global Petrol Prices (2019).
Note: The LCOE data is for projects commissioned in 2018. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world.

ENERGY TRANSFORMATION: KEY BENEFITS

1

AFFORDABLE, ACCESSIBLE ENERGY

- Lower system costs
- Distributed power for isolated communities
- Clean cooking

2

ENERGY SECURITY, CLIMATE-RESILIENCE

- Resiliance to climate, other risks
- Diversified energy supply
- Reduced energy demand with improved efficiency measures
- Improved infrastructure

3

CLEAN, CLIMATE-SAFE ECONOMIES

- Economic development
- Trade gains by moving away from fossil fuels
- Better air quality and reduced local pollution
- Improved education and empowered citizens

ENERGY TRANSFORMATION ROADMAP TO 2050

Latin America & Caribbean	2017	Where we are heading 2030 (PES)	2040 (PES)	2050 (PES)	Where we need to be 2030 (TES)	2040 (TES)	2050 (TES)
Energy (EJ)							
Supply (TPES)	27	35	42	46	29	31	31
Consumption (TFEC)	21	27	31	34	22	22	21
Renewables shares (modern)							
Supply (TPES)	30%	40%	42%	46%	53%	63%	73%
Consumption (TFEC)	30%	36%	37%	40%	47%	57%	67%
Power generation	65%	73%	75%	79%	85%	90%	93%
Electricity share in final energy consumption							
End-use consumption	18%	22%	24%	26%	26%	31%	39%
Industry	21%	24%	24%	25%	27%	29%	33%
Transport	0.2%	1%	1%	2%	9%	14%	24%
Buildings	45%	58%	63%	67%	61%	70%	78%
Renewable installed capacity (GW)							
Bioenergy	19	45	61	79	50	72	94
Hydropower	173	181	201	226	186	211	240
Solar PV	5	76	128	177	108	196	281
Wind	17	74	111	148	93	141	188
Biofuels							
Liquid biofuels (billions of litres per year)	31	61	74	79	61	75	73
Energy consumption per capita (GJ/capita)							
Consumption (TFEC) per capita	41	47	53	56	38	38	35
CO_2 emissions (energy-related)							
Annual level (Gt CO_2/yr)	1.2	1.4	1.6	1.7	1	0.8	0.6
Reduction vs. today	NA	19%	35%	38%	-21%	-35%	-54%

● Latin America & Caribbean	Where we are heading **Planned Energy Scenario 2016 - 2050** (PES)	Where we need to be **Transforming Energy Scenario 2016-2050** (TES)
Energy system investments (average annual, 2016-50) USD billion/year		
Power	39	45
– Renewable	21	28
– Non-renewable	5	3
– Power grids and system flexibility	13	15
Industry (RE + EE)	7	11
Transport (electrification + EE)	10	19
Buildings (RE + EE)	29	42
Biofuel supply	2.4	2.5
Renewable hydrogen – electrolysers	0.03	0.5

Note: RE = renewable energy; EE = energy efficiency

The findings in this report consider targets and developments as of April 2019. The wind and solar PV capacities in the Transforming Energy Scenario in 2030 in this report are slightly higher than the estimates presented in IRENA's reports (IRENA, 2019c; 2019d) which consider developments as of the third quarter of 2019.

SOCIO-ECONOMIC OUTLOOK TO 2050

● Latin America & Caribbean	2019e	2030	2050
Population (thousands) region-wide	474 076	505 546	535 802
GDP (USD 2015)			
GDP (million): PES	3 679 104	5 158 950	13 240 587
GDP (million): TES	3 700 954	5 194 779	13 563 681
GDP changes (million): TES vs. PES	21 850	35 828	323 093
GDP changes (%): TES vs. PES	0.6	0.7	2.4
Per capita GDP (thousand): PES	7.8	10.2	24.7
Per capita GDP (thousand): TES	7.8	10.3	25.3
Employment			
Economy-wide employment (thousands)			
Employment: PES	272 097	282 324	251102
Employment: TES	272 239	281 399	250 700
Employment changes: TES vs. PES	143	-925	-402
Employment changes (%): TES vs. PES	0.05	-0.33	-0.16

Latin America & Caribbean	2017	2030 (PES)	2050 (PES)	2030 (TES)	2050 (TES)
Energy sector jobs (thousands)					
Nuclear power	8	12	8	10	6
Fossil fuels	1180	1104	953	962	700
Renewables	2027	2575	2585	3295	3212
Energy efficiency	887	870	735	1211	818
Power grids and energy flexibility	364	466	403	463	455
Total	**4467**	**5026**	**4685**	**5941**	**5190**
Energy jobs in economy-wide employment (%)		1.80%	1.90%	2.10%	2.10%
Renewable energy jobs (thousands)					
Bioenergy	1620	1971	1875	2331	2133
Solar	64	173	301	474	570
Hydropower	300	320	264	351	306
Wind	42	109	143	136	199
Geothermal	1	2	2	2	4
Ocean	0	0	0	0	0
Total	**2027**	**2575**	**2585**	**3295**	**3212**
Renewable energy jobs in energy-sector employment (%)		51.2%	55.2%	55.5%	61.9%

Job differential in 2050 (thousands) TES vs. PES	
Economy-wide	-402
Changes in conventional energy (A)	-255
Changes in transition related technologies (B)	761
Net jobs (A+B)	506

▶ Jobs in 2050: TES / ● Latin America & Caribbean

Technology jobs (thousands)		Segment value chain (thousands)		Occupational requirements (thousands)	
Solar PV	276	Construction & installation	372	Workers and technicians	631
Solar water heaters (SWH)	293	Manufacturing	225	Experts	64
Onshore wind	195	Operation and maintenance	174	Engineers and higher degrees	52
Offshore wind	5	Biofuel supply	-	Marketing and administrative	25
Geothermal	4				
Total	**771**		**771**		**771**

Welfare improvement (%): TES vs. PES

Indicator	2030	2050
Economic	-0.1	0.2
Social	2.8	10.0
Environmental	2.2	4.6
Total	**5.0**	**14.8**

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World Bank Group (2019b), *Access to clean fuels and technologies for cooking (% of population)*, World Bank Group.

Renewable Energy Target in 2013

Table 2.2 Renewable energy targets in Latin America.

Country	Renewable energy target	Reference	Year
Argentina	• 8% of electricity consumption by 2017 • 20% of electricity consumption by 2025	Law 27190 promoting the use of renewable energy sources Law 27190 promoting the use of renewable energy sources	2015 2015
Belize	• 50% of electricity generation by 2033 • 15 MW additional hydro by 2033 • 5 MW solid waste generation by 2020	National Sustainable Energy Strategy National Sustainable Energy Strategy National Sustainable Energy Strategy	2012 2012 2012
Bolivia	• Increase hydro to 70% of total generation and 4% of other renewable energy by 2025 • 193 MW renewable generation by 2025	Bolivia Electric Plan 2025 Bolivia Electric Plan 2025	2014 2014
Brazil	• 45.2% of primary energy supply by 2024 (from 39.4% in 2014) • 86% of electricity generation by 2024 • Increase wind power share to 8% in 2024 (from 2% currently) • 23% of electricity generation from non-hydro renewables by 2030	10-Year Energy Expansion Plan 2024 10-Year Energy Expansion Plan 2024 10-Year Energy Expansion Plan 2024 Intended Nationally Determined Contribution	2014 2014 2014 2015
Chile	• 20% of electricity generation by 2025 • At least 60% of electricity generation by 2035 • 70% of new capacity installed between 2015 and 2050	Law 20698: Expansion of the energy mix through non-conventional renewables Energy Roadmap 2050 Energy Roadmap 2050	2013 2015 2015
Colombia	• Total renewable installed capacity of 6,179 MW[1] by 2028, including 3,689 MW of non-hydropower	Generation Expansion Plan 2014-2028	2014
Costa Rica	• 98% of electricity generation by 2035 (74% hydropower, 15% geothermal, 9% wind-biomass-solar)	Generation Expansion Plan 2014-2035	2014
Ecuador	• 60% of installed capacity by 2017 (from 43% in 2012) • 4.2 GW hydropower by 2022 • 277 MW non-hydro renewables by 2022	Institutional Strategic Plan 2014-2017 Electrification Master Plan 2013-2022 Electrification Master Plan 2013-2022	2014 2013 2013
El Salvador	• By 2026: 60 MW wind, 90 MW solar PV, 200 MW solar thermal, 60-89 MW geothermal, 162.7 MW small hydro (<20 MW), 45 MW biomass and 35 MW biogas	Masterplan for the Development of Renewable Energy	2012
Guatemala	• 60% of electricity generated by 2022 • 80% of electricity generated by 2027	Electric System Expansion Plan 2014-2028 National Energy Policy 2013-2027	2014 2012
Guyana	• CARICOM target for renewable electricity: 20% by 2017, 28% by 2022 and 47% by 2027	Caribbean Sustainable Energy Roadmap	2013
Honduras	• 60% of energy demand supplied by renewables by 2022 • 80% of electricity generation by 2034	National Vision and Plan 2010-2038 National Vision and Plan 2010-2038	2010 2010
Mexico	• Clean energy[2] share of total electricity generation: 25% by 2018, 30% by 2021, 35% by 2024 • By 2018: 13,030 MW hydropower, 8,922 MW wind, 1,018 MW geothermal, 748 MW bioenergy and 627 MW solar	Energy Transition Law Long-term Program of Renewable Energy Development	2015 2014
Nicaragua	• Increase the renewable share of electricity from 51% in 2013 to 91% in 2027	Electricity Expansion Plan 2013-2027	2013
Panama	• Install an additional 706.3 MW hydropower between 2009 and 2023 • At least 70% of electricity from renewables by 2050[3]	National Energy Plan 2009-2023 National Energy Plan 2015-2050 (upcoming)	2009 2016
Peru	• 5% of electricity generation by 2018 (excluding hydro) • 60% of electricity generation by 2018 (including hydro)	Decree 1002 National Energy Plan 2014-2025	2008 2014
Suriname	• CARICOM target for renewable electricity: 20% by 2017, 28% by 2022 and 47% by 2027	Caribbean Sustainable Energy Roadmap	2013
Uruguay	• 50% of the primary energy mix by 2015 • 90% of electricity generation by 2015[4]	National Energy Policy 2005-2030 National Energy Policy 2005-2030	2008 2008
Venezuela	• 613 MW of additional renewable electricity capacity between 2013 and 2019, of which 500 MW is wind	Development Plan for the National Electric System 2013-2019	2013

1. 1,422 MW of wind; 2,267 MW of biomass, solar and geothermal; 2,490 MW of hydropower.
2. "Clean energy" includes renewables, co-generation, nuclear energy, fossil fuels with CCS and "other low-carbon technologies".
3. An October 2015 working document from the National Energy Commission mentions electricity generation from 2.1% solar and 8% wind; see http://www.energia.gob.pa/admin/gal/277/files//Presentacion%20Escenario%20de%20Referencia.pdf
4. 40% of non-conventional renewable energy sources (mainly wind, but also solar PV and biomass waste), in addition to 55% hydropower; see Intended.
Nationally Determined Contribution at http://www4.unfccc.int/submissions/INDC/Published Documents/Uruguay/1/INDC Uruguay English-unofficialtranslation).pdf

ABBREVIATIONS

°C	degrees Celsius
bcm	billion cubic metres
BES	Baseline Energy Scenario
bln	billion
CCS	carbon capture and storage
CCUS	carbon capture, utilisation and storage
CDR	carbon dioxide removal
CHP	combined heat and power
CIP	Climate Investment Platform
CO_2	carbon dioxide
CSP	concentrating solar power
DDP	Deeper Decarbonisation Perspective
DH	district heat
DRI	direct reduced iron
EJ	exajoule
EU	European Union
EUR	Euro
EV	electric vehicle
FCEV	fuel cell electric vehicle
G20	Group of Twenty
GCF	Green Climate Fund
GDP	gross domestic product
GJ	gigajoule
Gt	gigatonne
GW	gigawatt
GWEC	Global Wind Energy Council
GWh	gigawatt-hour
H_2	Hydrogen
IEA	International Energy Agency
IMF	International Monetary Fund
IMO	International Maritime Organization
IRENA	International Renewable Energy Agency
kg	kilogram
kWh	kilowatt-hour
LCOE	levelised cost of electricity
LNG	liquefied natural gas
LULUCF	land use, land-use change and forestry
m^2	square metre
MENA	Middle East and North Africa
mln	million
Mt	megatonne
Mtce	megatonne of coal equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt-hour
N_2O	nitrous oxide
NDC	Nationally Determined Contribution
O&M	operation and maintenance
OECD	Organisation for Economic Co-operation and Development
PES	Planned Energy Scenario
PPA	power purchase agreement
ppt	percentage point
PV	photovoltaic
R&D	research and development
RE	renewable energy
REmap	renewable energy roadmap analysis by IRENA
SDG	Sustainable Development Goal
SEforALL	Sustainable Energy for All
SF6	sulphur heaxfluoride
t	tonne
TES	Transforming Energy Scenario
TFEC	total final energy consumption
TJ	terajoule
toe	tonne of oil equivalent
TPES	total primary energy supply
TW	terawatt
TWh	terawatt-hour
UK	United Kingdom
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar
VRE	variable renewable energy
WHO	World Health Organization
yr	year