Global Energy Monitor

A Race to the Top

2023

LATIN AMERICA

Global Energy Monitor

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Global Energy Monitor is a nonprofit research organization developing information on energy projects worldwide. Through its Global Solar Power Tracker and Global Wind Power Tracker projects, Global Energy Monitor provides annual updates on utility-scale solar and wind power facilities. Global Energy Monitor data is used by the International Energy Agency (IEA), the OECD Environment Directorate, UN Environment Programme, U.S. Treasury Department, and the World Bank. For more information, visit www.globalenergymonitor.org.

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ABOUT THE COVER

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FURTHER RESOURCES

For additional data on proposed and existing solar projects, see Summary Data of the Global Solar Power Tracker. For links to reports based on the Global Solar Power Tracker data, see Reports & Briefings. To obtain primary data from the Global Solar Power Tracker, see Download Data.

Supplementary information on the methodology used in calculations for this report can be found on our methodology wiki page.

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A Race to the Top: Latin America

WIND AND SOLAR UTILITY-SCALE BUILDOUT GAINS SPEED IN BRAZIL, CHILE, AND COLOMBIA, WHILE MEXICO FALLS BEHIND

Sophia Bauer, Kasandra O'Malia, Shradhey Prasad, Gregor Clark, and Ingrid Behrsin

SUMMARY

Rich in wind and solar resources, Latin America has the potential to be a global leader for renewable energy with enough existing and planned projects to meet regional net zero targets by 2030. With more than 319 GW of utility-scale[1] solar and wind capacity either announced,[2] in pre-construction,[3] or under construction,[4] the region is positioned to grow its large-scale solar and wind power capacity by more than 460% by 2030 over the 69 GW (27.6 GW solar, 41.5 GW wind) currently operating if all of these projects were to come online. This represents an almost 70% growth over the region's current total electrical capacity from all sources (457 GW).[5]

Brazil, Chile, Colombia, and Mexico are currently at the vanguard for operating utility-scale solar and wind farms in Latin America, with a collective capacity of over 57 GW. But while Brazil, Chile, and Colombia continue to ramp up development, Mexico has stalled; even if all prospective[6] projects were to come online, the country would only reach approximately 70% of its pledge to bring 40 GW of solar and wind by 2030.[7]

Most countries in the region have high solar irradiance and a strong potential for offshore wind development. However, the three regional leaders owe their continued utility-scale solar and wind growth to well-established energy auctions, openness to private investment, the economic potential of green hydrogen exports, the decreasing cost of solar and wind installations, and policy responses to climate change. In contrast, while Mexico was a standout leader for utility-scale solar and wind development between 2013 and 2021, national energy policy amendments passed in May 2021 have dampened the utility-scale solar and wind forecast. While the region continues to thrust its way towards a renewables future, these differing trajectories highlight the pivotal influence of national policy landscapes.

1. GEM catalogs all solar installations greater than 20 MW and all wind installations greater than 10 MW.
2. A project is categorized as being announced if it has been publicly reported but has not yet moved actively forward by applying for permits or seeking land, material, or financing.
3. Pre-construction projects have publically reported achieving permits, financing, land acquisition, power purchase agreements and/or material but have not yet begun active construction.
4. Projects are considered under construction when site preparation and equipment installation are underway.
5. IRENA (2022). Renewable Energy Statistics 2022, International Renewable Energy Agency, Abu Dhabi.
6. Prospective projects are any projects that are either announced, in pre-construction, or under construction.
7. "Mexico Pledges to Reach 40GW of Wind and Solar by 2030." BNAmericas, November 15, 2022, accessed February 1, 2023, https://www.bnamericas.com/en/news/mexico-pledges-to-reach-40gw-of-wind-and-solar-by-2030.

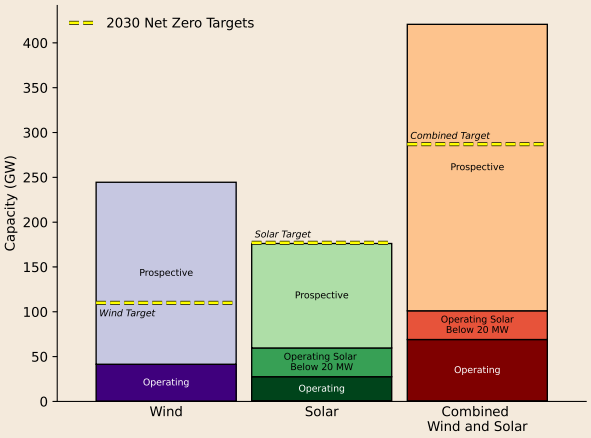
REGIONAL BACKGROUND

High solar irradiance and abundant onshore and offshore wind potential across Latin America provide the region with a strong foundation on which to construct a reliable utility-scale renewable energy network. The global pressure to move away from fossil fuels, accompanied by vanishing financing for coal projects,[8] stranded assets risks[9] around fossil fuel projects, loss of social license to build fossil fuel projects (despite COVID-19 recovery funding[10] frequently prioritizing fossil fuels), and the effectiveness of opposition campaigns[11] against fossil fuel projects all serve to enhance the attractive baseline conditions for solar and wind development.

Costa Rica introduced the region's first utility-scale wind farm, simply named Plantas Eólicas (PESA), in 1996. As the cost of solar and wind installations continued to drop between 2010–2020 (89% decrease for solar, 70% decrease for wind),[12] utility-scale solar and wind developments spread more widely. The first solar farms over 1 MW began to appear in Latin America in 2011.[13,14] Chile established Latin America's first Concentrated Solar Project (CSP), the Cerro Dominador Solar Complex, in 2021. As the possibility of replacing fiscal revenue previously earned from fossil fuels with low-carbon sources, including green hydrogen, becomes more feasible, the impetus for moving towards renewable energy continues to grow.

According to the Global Wind Power Tracker and the Global Solar Power Tracker, if all the prospective utility-scale solar and wind power projects in the region were to come online by 2030, these new projects, plus currently operating projects, will account for roughly 220% of the region's wind goal and 80% of the solar goal set by the IEA's roadmap to net zero emissions.[15,16] Taking into account existing distributed and smaller-scale solar capacity, should Latin America follow through on all its prospective larger-scale projects, it will be on pace to meet, and even exceed, its 2030 net zero renewable energy goals.[17]

Figure 1: Wind and Solar Buildout Comparison with IEA's Net Zero 2030 Scenario for Latin America.[18]



8. "Global Coal Project Finance Tracker." 2023, accessed January 31, 2023, https://globalenergymonitor.org/projects/global-coal-project-finance-tracker/.

9. Binsted, Matthew et al. "Stranded Asset Implications of the Paris Agreement in Latin America and the Caribbean." IOP Science, April 3, 2020, accessed January 31, 2023, https://iopscience.iop.org/article/10.1088/1748-9326/ab506d.

10. Aráujo, José Vega et al. "Apoyos Públicos a los Combustibles Fósiles en Cuatro Países Latinoamericanos en el Contexto de COVID-19." Stockholm Environment Institute, November 2021, accessed January 31, 2023, https://www.sei.org/wp-content/uploads/2021/11/vegaaraujo-et-al-2021.pdf.

11. "Ambientalistas Tentam Barrar na Justiça Projetos Termeléctricos em Macaé." EPBR, November 4, 2022, accessed January 31, 2023, https://epbr.com.br/ambientalistas-tentam-barrar-na-justica-projetos-termeletricos-em-macae.

12. Marcacci, Silvio. "Renewable Energy Prices Hit Record Lows: How Can Utilities Benefit From Unstoppable Solar And Wind?" Forbes, accessed December 7, 2022. https://www.forbes.com/sites/energyinnovation/2020/01/21/renewable-energy-prices-hit-record-lows-how-can-utilities-benefit-from-unstoppable-solar-and-wind/.

13. "Solar Power Plants in Brazil: Financing and Construction." ESFC Investment Group, accessed February 1, 2023, https://esfccompany.com/en/articles/solar-energy/solar-power-plants-in-brazil/.

14. "First Large Scale Solar Power Plant Inaugurated in Costa Rica." EV Wind, November 25, 2012, accessed February 1, 2023, https://www.evwind.es/2012/11/25/first-large-scale-solar-power-plant-inaugurated-in-costa-rica/26338.

15. "World Energy Outlook 2022." International Energy Agency, 2022. https://www.iea.org/reports/world-energy-outlook-2022.

16. "World Energy Outlook 2020." International Energy Agency, 2020. https://www.iea.org/reports/world-energy-outlook-2020.

17. For details on the methodology used to determine these numbers please see our methodology page.

18. Operating solar below 20 MW is the difference between GEM's utility-scale solar data and country level values found in IRENA's Renewable Energy Statistics 2022 dataset.

CURRENT UTILITY-SCALE SOLAR AND WIND GENERATION

Latin America currently has over 69 GW of operating utility-scale solar capacity (27.6 GW) and wind capacity (41.5 GW), which amounts to slightly more than 15% of the region's total electrical capacity.[19]

The largest operating utility-scale solar project is Degollado Aljaval solar farm (384 MW) in Mexico. The largest operating wind project is Reynosa wind farm (424 MW) in Mexico.

Figure 2: Development of Current and Prospective Wind Capacity in Latin America.

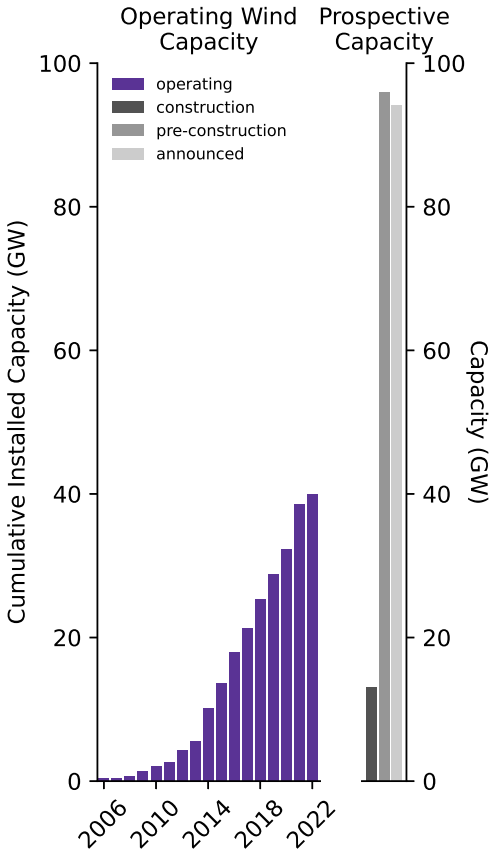
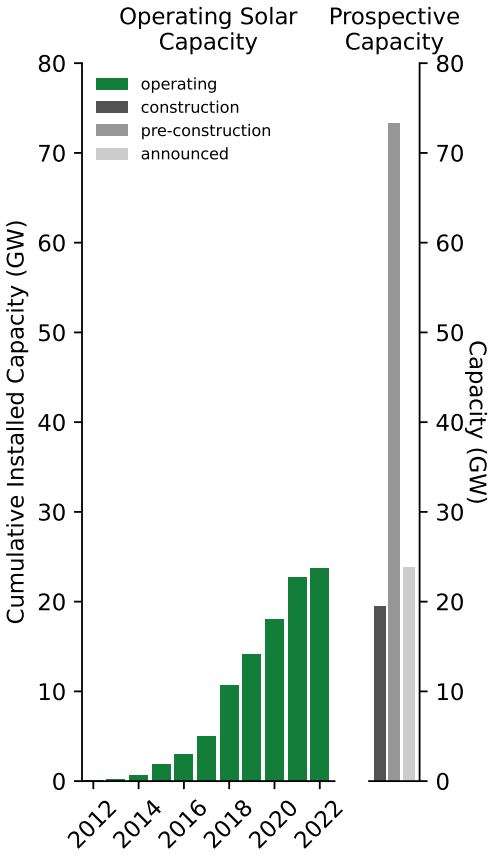


Figure 3: Development of Current and Prospective Utility Scale Solar Capacity in Latin America.



19. Country level total capacity across all energy types from IRENA Renewable Energy Statistics 2022.

PROSPECTIVE UTILITY-SCALE SOLAR AND WIND GENERATION

Latin America is pursuing utility-scale solar and wind projects that together would increase its renewables capacity by more than 319 GW (460%) by 2030, with more than 116 GW of announced, pre-construction, and in construction utility-scale solar projects and more than 203 GW of wind projects scheduled to come online.[20] The region's largest prospective utility-scale solar project is Brazil's 5.7 GW Berço Das Gerais Solar Park, which, as of January 2023, has not yet announced a start date. The largest prospective

Table 1: Operating and Prospective Wind and Solar Capacity in Latin America, Listed Alphabetically by Country[21]

Country	Wind and Solar Operating Capacity (MW)	Wind and Solar Operating as % of Total Country Capacity[21]	Wind and Solar Prospective Capacity (MW)	Wind Operating Capacity (MW)	Wind Prospective Capacity (MW)	Solar Operating Capacity (MW)	Solar Prospective Capacity (MW)
Argentina	4,742	11%	2,142	3,707	1,282	1,035	860
Aruba	30	10%	0	30	0	0	0
Barbados	0	0%	100	0	30	0	70
Bolivia	292	7%	355	132	45	160	310
Bonaire, Sint Eustatius and Saba	11	24%	0	11	0	0	0
Brazil	26,885	14%	217,185	21,493	160,185	5,392	57,000
Chile	10,050	37%	38,157	3,921	21,459	6,129	16,698
Colombia	455	2%	37,052	52	11,968	403	25,084
Costa Rica	399	11%	0	399	0	0	0
Cuba	39	1%	999	0	999	39	0
Curaçao	47	20%	0	47	0	0	0
Dominican Republic	740	13%	2,265	357	100	383	2,165
Ecuador	16	0%	668	16	410	0	258
El Salvador	319	13%	41	54	0	265	41
French Guiana	0	0%	55	0	0	0	55
Guadeloupe	41	7%	0	41	0	0	0
Guatemala	199	5%	68	106	68	93	0
Guyana	0	0%	25	0	25	0	0
Haiti	0	0%	90	0	0	0	90
Honduras	857	30%	152	235	152	622	0
Jamaica	171	12%	173	99	0	72	173
Martinique	14	3%	22	14	22	0	0
Mexico	20,327	21%	6,713	8,209	1,450	12,119	5,264
Nicaragua	189	10%	86	189	0	0	86
Panama	556	15%	2,468	337	1,152	219	1,316
Peru	735	5%	10,029	407	3,658	328	6,371
Puerto Rico	226	3%	408	101	0	125	408
Saint Kitts and Nevis	0	0%	38	0	0	0	38
Trinidad and Tobago	0	0%	112	0	0	0	112
Uruguay	1,720	35%	150	1,526	0	194	150
Virgin Islands (U.S.)	0	0%	26	0	26	0	0

20. This includes 4.6 GW of capacity in Colombia slated to come online in 2032.

21. Country level total capacity across all energy types from IRENA Renewable Energy Statistics 2022.

onshore wind project is Chile's 10 GW H2 Magallanes wind farm in San Gregorio, Magallanes region, with a projected commissioning year of 2027; it is being earmarked primarily for green hydrogen production. The largest prospective offshore wind project is Brazil's 6.5 GW Ventos Do Sul offshore wind farm, which the operator, Ocean Winds, anticipates will also come online in 2027. Indeed, Brazil's 128 GW of prospective offshore wind contribute to the country's status as the world leader in terms of prospective wind energy; its prospective utility-scale solar capacity (57 GW) also places it in the top five globally.

CURRENT RENEWABLE ENERGY LEADERS IN LATIN AMERICA

Of the top players in utility-scale solar and wind in Latin America, Brazil leads the region in combined capacity with a total of 26.9 GW: utility-scale solar (5.4 GW) and wind (21.5 GW). Due to its early investments in the renewables sector, Mexico ranks second in the region for utility-scale solar and wind.

When examined as a percentage of the total electrical capacity across all fuel sources, Chile, Uruguay, and Honduras lead with a third or more of their respective capacities coming from utility-scale solar and wind installations. Indeed, early initiatives in Honduras to install solar power made it the first non-island nation in the world to achieve more than 10% of their electricity from solar power in 2016.[22] The continued utility-scale solar and wind installations in Honduras could begin to offset the Sistema de Interconexión Eléctrica de los Países de América Central (SIEPAC)'s reliance on climate change-vulnerable hydropower and accelerate the development of the Clean Energy Corridor of Central America (CECCA).[23]

Table 2: Top 5 Countries for Total Operating Utility-Scale Solar and Wind Capacity

Rank	Country	Operational Wind and Solar Capacity (GW)
1	Brazil	27
2	Mexico	20
3	Chile	10
4	Argentina	5
5	Uruguay	2

Table 3: Top 5 Countries for Operating Utility-Scale Solar and Wind Capacity as a Percentage of Total Electrical Capacity Across All Sources

Rank	Country	Operational Wind and Solar as % of Total Country Capacity
1	Chile	37%
2	Uruguay	35%
3	Honduras	30%
4	Bonaire, Sint Eustatius and Saba	24%
5	Mexico	21%

22. Díaz López, Blanca. "Honduras is the First Nation with 10% Solar in its Electricity Mix." PV Magazine, January 30, 2017, accessed January 31, 2023, https://www.pv-magazine.com/2017/01/30/honduras-first-country-in-the-world-with-10-of-solar-in-its-electricity-mix/.

23. Barrera, Fabian. "Central American Electrical Interconnection System (SIEPAC)." IRENA, accessed January 31, 2023, https://www.unescap.org/sites/default/d8files/event-documents/2-3_IRENA_Barrera.pdf.

Figure 4: Operating Utility-Scale Solar and Wind Capacity (Combined) in Latin America.

Figure 5: Operating Utility-Scale Wind Capacity in Latin America.

Figure 6: Operating Utility-Scale Solar Capacity in Latin America.

EMERGING RENEWABLE ENERGY GROWTH IN LATIN AMERICA

The top five leaders in terms of prospective utility-scale solar and wind capacity additions between 2022–2030[24] are shown in Table 4.

The top countries in the forward-looking solar and wind landscape in Latin America—Brazil, Chile, and Colombia—are steadily seeing increasing growth in prospective projects. Brazil, Chile, and Colombia are all on track to meet their nationally-stated solar and wind targets. According to the 2050 National Energy Plan of Brazil, Brazil expects to have 194 GW of wind power and 91 GW of centralized solar power (a combined 285 GW) while also acknowledging that the country may surpass these numbers in certain scenarios.[25] As of 2030, if Brazil were to actualize all of its prospective projects, it would have 244 GW of utility-scale solar and wind, leaving an additional two decades to close the gap of 41 GW. 244 GW of solar and wind would be enough to offset all 32 GW of its currently operating fossil fuel projects, ease the reliance on its 109 GW of drought-prone hydroelectric projects, and have capacity left to address increased demand.

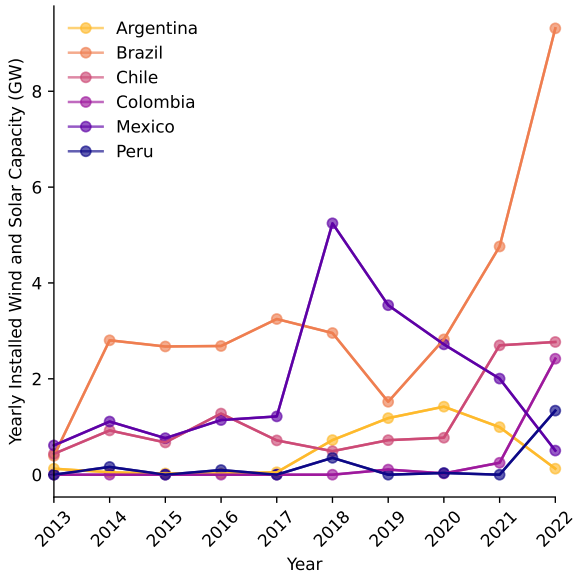
Table 4: Top 5 Countries for Prospective Utility-Scale Solar and Wind Capacity in 2030[26]

Rank	Country	Prospective Wind and Solar Capacity (GW)
1	Brazil	217
2	Chile	38
3	Colombia	37
4	Peru	10
5	Mexico	7

Chile's June 2022 release of the Roadmap for an Accelerated Energy Transition (Hoja de Ruta para una Transición Energética Acelerada) updates the national goal to 100% reliable, renewable energy by 2030.[27] The plan necessitates at least 15 GW installed capacity of wind and solar (photovoltaic and CSP) as well as increasing investment in energy storage. Provided that Chile can actualize all of its prospective utility-scale solar and wind projects by 2030, installations would be more than three times greater than what the plan requires at 48 GW.

Colombia has set a goal to reach 4 GW of renewable energy by 2030.[28] The 37 GW of operating plus prospective capacity by 2030[29] is nine times larger than the national goal.

Figure 7: Wind and Utility-Scale Solar Installations by Year for Top 5 Prospective Countries and Argentina.



24. This includes 4.6 GW of capacity in Colombia slated to come online in 2032.

25. "Plano Nacional de Energia: PNE 2050." Ministério de Minas e Energia do Brasil, https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-227/topico-563/Relatorio%20Final%20do%20PNE%202050.pdf.

26. This includes 4.6 GW of capacity in Colombia slated to come online in 2032.

27. "Hoja de Ruta para una Transición Energética Acelerada: Visión del Coordinador Eléctrico Nacional." June 2022, accessed December 2022, https://www.coordinador.cl/wp-content/uploads/2022/06/8_digital_Informe_Coordinador_2.5.pdf.

28. "Renewables 2021 - Analysis and Forecast to 2026." International Energy Agency (IEA), 2021, 175, https://iea.blob.core.windows.net/assets/5ae32253-7409-4f9a-a91d-1493ffb9777a/Renewables2021-Analysisandforecastto2026.pdf.

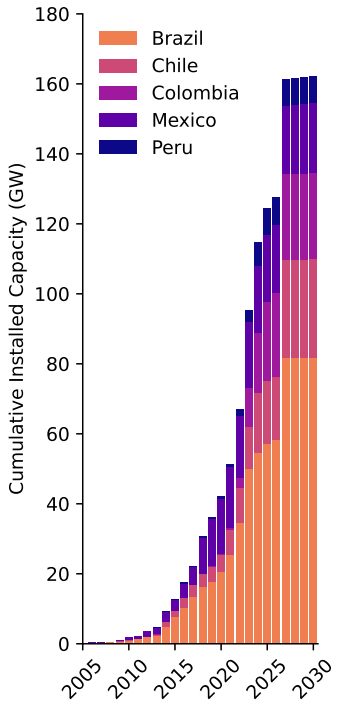
29. This includes 4.6 GW of capacity in Colombia slated to come online in 2032.

Compared to the top three prospective capacity countries in Latin America, Mexico's utility-scale solar and wind installations have declined. Mexico was a standout leader for utility-scale solar and wind power development for many years with strong annual growth, and a November 2022 announcement at COP27 stated Mexico would be aiming for 40 GW of renewable energy to be operational in the energy matrix by 2030.[30] However, meeting this goal necessitates the installation of 18 GW[31] of projects between 2022–2030, and Mexico's operating plus prospective utility-scale solar and wind capacity for 2030 falls well short of this goal. In order to achieve it, Mexico must bring all prospective projects to fruition and bring online an *additional* 11 GW of solar and wind projects.[32]

Peru experienced a lull in utility-scale solar and wind deployment between 2017 and 2022, but the outcome of the 2022 energy auction reflects a promising uptick of prospective projects.[33] Peru has more prospective projects than Mexico (10.0 GW vs. 6.7 GW). Should all of the region's prospective projects come to fruition, the region's top five utility-scale solar and wind generators in 2030 would see Peru moving into the top five countries for operating capacity, in front of Argentina.

Argentina set a goal in 2015 to have 10 GW of renewable energy in its electrical matrix by 2025.[34] With 4.7 GW of utility-scale solar and wind installations already operating, and 1.2 GW of prospective capacity in the queue by 2025, Argentina's total operating capacity between these two sources would only contribute 5.9 GW (59%) of this target. And while the country currently has just over 10 GW of hydroelectric capacity operating,[35] the 2025 target limits eligible hydropower facilities to only those units that are 50 MW or smaller.[36] In addition, 5.8 GW of hydroelectric power faces expiring concessions over the next 15 years.[37] With hydropower becoming increasingly vulnerable to drought, Argentina must invest more aggressively in solar and wind to ensure a more resilient renewable energy portfolio.

Figure 8. Cumulative Utility-Scale Solar and Wind Capacity Development by Year for Top 5 Prospective Countries.



30. Morland, Sarah. "Mexico Vows to Double Renewable Energy Capacity by 2030." Reuters, accessed December 7, 2022, https://www.reuters.com/business/cop/mexico-vows-double-renewable-energy-capacity-by-2030-2022-11-15/.

31. Mexico has 20.3 GW of operating utility-scale solar and wind. Using IRENA's Renewable Energy Statistics 2022, we estimate Mexico has 2 GW of additional operating solar below GEM's 20 MW threshold.

32. Projects below the Global Wind and Global Solar Power Trackers' thresholds and distributed solar will also contribute to Mexico meeting this national goal.

33. Sánchez Molina, Pilar. "Peru Wants to Tender 2 GW of Renewables This Year." PV Magazine, January 31, 2022, accessed December 12, 2022, https://www.pv-magazine.com/2022/01/31/peru-wants-to-tender-2-gw-of-renewables-this-year/.

34. Podestá, Andrea et al. "Políticas de atracción de inversiones para el financiamiento de la energía limpia en América Latina." https://repositorio.cepal.org/bitstream/handle/11362/48084/1/S2200585_es.pdf.

35. IRENA Renewable Energy Statistics 2022.

36. "Ley 27191." Honorable Congreso de la Nación Argentina, October 21, 2015, accessed February 1, 2023, https://www.argentina.gob.ar/normativa/nacional/253626/texto.

37. "As Hydropower Concessions Approach End, Argentina Ponders Future Course." BNAmericas, March 9, 2022, accessed February 1, 2023, https://www.bnamericas.com/en/news/as-hydropower-concessions-approach-end-argentina-ponders-future-course.

All of the offshore wind projects in Latin America are currently located along the coast of South America. The extensive offshore wind potential along all of the coastlines of Latin America will likely be utilized as countries take note of the successes and setbacks encountered by the first large-scale offshore wind projects in Brazilian and Colombian waters.[38]

Figure 9. Prospective Utility-Scale Solar and Wind Capacity (Combined) in Latin America.

Figure 10. Prospective Utility-Scale Wind Capacity in Latin America.

Figure 11. Prospective Utility-Scale Solar Capacity in Latin America.

38. "Latin America Offshore Wind to see 34 GW of Installed Capacity by 2050." Wood Mackenzie, October 18, 2022, accessed January 31, 2023, https://www.woodmac.com/press-releases/latin-america-offshore-wind-to-see-34-gw-of-installed-capacity-by-2050/.

Utility-Scale Solar and Wind Energy Growth as a Supplement to Unreliable Hydropower in Latin America

As Latin American countries come to terms with the fragility of their energy systems, and especially those systems' reliance on hydropower, they are increasingly turning to solar and wind. Changing rainfall patterns and the increasingly scarce water resources are exceedingly important factors in the push by hydropower-dependent Latin American countries for rapid adoption of utility-scale solar and wind.[39] Brazil, historically reliant on hydropower, has been a role model for the diversification of its renewable energy network since the 2001 drought.[40] Tapping solar and wind to fill the apparent gaps in hydropower systems is a large pull factor, especially for countries looking to move away from fossil fuels.[41]

Green Energy Export Opportunities Drive the Region's Large-Scale Renewables Buildout

Potential energy surplus from the buildout of utility-scale solar and wind could allow Latin American countries to compete in the global energy market. Embracing the natural resources of solar and wind on a large scale can set Latin American countries up to meet their energy needs sustainably while simultaneously becoming important energy exporters in the global energy transition.

Low- and zero-carbon hydrogen export offers near- and long-term potential for Latin America's economic outlook. Indeed, green hydrogen production has become an economically-motivating factor for offshore wind development in Latin America. Several countries, including Chile,[42] Uruguay,[43] Ecuador,[44] Argentina,[45] Paraguay,[46] and Brazil[47] have crafted and adopted national hydrogen strategies.[48] From 2020 to 2021 the global hydrogen market was valued at $130 billion and is expected to grow over 9% per year through 2030.[49] Green hydrogen agreements, such as those that Chile has signed with European Union

39. "Climate Impacts on Latin American Hydropower." International Energy Agency (IEA), https://iea.blob.core.windows.net/assets/8fa86b9d-470c-41a6-982e-70acd3fbdda4/ClimateImpactsonLatinAmericanHydropower_WEB.pdf.

40. Atxalandabaso, Izei. "Renewable Energy in Latin America: 5 Renewable Energy Trends Emerging from South of Rio Grande." Rated Power, April 16, 2021, accessed January 31, 2023, https://ratedpower.com/blog/renewable-energy-latin-america/.

41. "Renewable Energy Auctions in Colombia: Context, Design, and Results." IRENA, March 2021, accessed December 8, 2022, p. 9, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/March/IRENA_auctions_in_Colombia_2021.pdf.

42. "National Green Hydrogen Strategy." Ministerio de Energía de Chile, November 2020, accessed December 2022, https://energia.gob.cl/sites/default/files/national_green_hydrogen_strategy_-_chile.pdf.

43. "Hoja de Ruta del Hidrógeno Verde en Uruguay." Ministerio de Industria, Energía, y Minería de Uruguay, June 2022, accessed December 2022, https://www.gub.uy/ministerio-industria-energia-mineria/sites/ministerio-industria-energia-mineria/files/documentos/noticias/H2_final_14jul22_digital.pdf.

44. "Ecuador Diseña Una Hoja de Ruta Para La Producción y Uso Del Hidrógeno Verde - El Periódico de La Energía." accessed December 7, 2022, https://elperiodicodelaenergia.com/ecuador-disena-hoja-ruta-produccion-uso-hidrogeno-verde/.

45. "Hacia una Estrategia Nacional: Hidrógeno 2030." Consejo Económico y Social, May 2021, accessed December 2022, https://www.argentina.gob.ar/sites/default/files/segundo_documento_ces_hidrogeno.pdf.

46. "Hacia la Ruta del Hidrógeno Verde en Paraguay." Viceministerio de Minas y Energía, June 2021, accessed December 8, 2022, https://www.ssme.gov.py/vmme/pdf/H2/H2%20Marco_Conceptual_DIGITAL.pdf.

47. "Programa Nacional do Hidrogênio: Proposta de Diretrizes." July 2021, accessed January 9, 2023, https://www.gov.br/mme/pt-br/assuntos/noticias/mme-apresenta-ao-cnpe-proposta-de-diretrizes-para-o-programa-nacional-do-hidrogenio-pnh2/HidrognioRelatriodiretrizes.pdf.

48. "Hydrogen in Latin America" From Near-Term Opportunities to Large-Scale Deployment." International Energy Agency (IEA), August 2021, accessed December 2022, https://www.iea.org/reports/hydrogen-in-latin-america.

49. Kane, Michael Kobina and Stephanie Gil, "Green Hydrogen: A Key Investment for the Energy Transition." June 23, 2020, https://blogs.worldbank.org/ppps/green-hydrogen-key-investment-energy-transition.

ports,[50] are one approach to ensuring Latin America can secure a share of this growing market.

However, concerns over the environmental and social integrity of green hydrogen export are already emerging in Latin America, particularly surrounding extractivist models which may be used for production.[51] Protests across Latin America since 2020 have focused on resisting new forms of extractivism during the energy transition, with some areas with especially high levels of wind resources, such as La Guajira, Colombia and Oaxaca, Mexico, rocked by social movements demanding deeper local participation in planning processes and more equitable distribution of economic benefits associated with wind developments.[52,53,54] Utility-scale projects, especially when they are intended for energy export, should ensure they are conducting extensive impact assessments (social and environmental) and community consultations to avoid harmful unintended consequences,[55,56] and ensure the implementation of locally-welcomed renewable energy investments.

Increased interconnectivity of the electrical grids and transmission line network enhancements in Latin America is a crucial step for the region to grow as an energy exporter. In particular, intraregional connections that balance alternating seasonal peaks of renewable energy generation would provide a path for stabilizing energy prices throughout the year.[57] In January 2023, Colombian President Petro introduced the idea of an American electrical grid from Patagonia to Alaska to make energy export to Canada and the United States a viable option for consistent exports.[58]

For example, Mexico's Puerto Peñasco is the first of several utility-scale solar developments along the border with the United States that could be used for energy export.[59] If the solar projects and corresponding transmission networks come to fruition, Mexico has secured commitments from U.S. companies to purchase the energy.[60] Early concepts for utility-scale solar in the Atacama desert of Chile bound for export to Asian countries provide another avenue for Latin America to become a solar energy exporter.[61]

50. Garip, Patricia. "Chile Signs Green H2 Agreement with EU Ports." Argus Media, November 9, 2021, accessed January 30, 2023, https://www.argusmedia.com/en/news/2271972-chile-signs-green-h2-agreement-with-eu-ports.

51. Abarca del Río, Rodrigo et al. "The Chilean Potential for Exporting Renewable Energy." Comité Científico de Cambio Climático, November 2021, accessed December 8, 2022, https://comitecientifico.minciencia.gob.cl/wp-content/uploads/2021/11/The_Chilean_Potential_for_Exporting_Renewable_Energy_web.pdf.

52. John Feffer, "Building a Post-Extractivist Future for Latin America - FPIF." Foreign Policy In Focus, February 22, 2022, https://fpif.org/building-a-post-extractivist-future-for-latin-america/.

53. Guerra Curvelo, Weildler. "A merced de los vientos. Los pueblos de La Guajira y los parques eólicos." Gatopardo (blog), June 8, 2022, https://gatopardo.com/reportajes/a-merced-de-los-vientos-los-pueblos-de-la-guajira-y-los-parques-eolicos/.

54. Dunlap, Alexander. "Wind Energy: Toward a 'Sustainable Violence' in Oaxaca: In Mexico's Wind Farms, a Tense Relationship between Extractivism, Counterinsurgency, and the Green Economy Takes Root." accessed December 7, 2022, https://www.researchgate.net/publication/321782558_Wind_Energy_Toward_a_Sustainable_Violence_in_Oaxaca_In_Mexico's_wind_farms_a_tense_relationship_between_extractivism_counterinsurgency_and_the_green_economy_takes_root.

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56. Pisarenko, Natacha and Daniel Politi. "Patagonia Condor Repopulation Drive Faces Wind Farm Threat." AP NEWS, October 18, 2022, https://apnews.com/article/business-mountains-argentina-birds-condors-5ef58ff6bfaef6a653c7822f55a0bba3.

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60. Hernández, Enrique. "CRE da luz verde a la planta solar de Puerto Peñasco." Forbes México, September 5, 2022, https://www.forbes.com.mx/cre-da-luz-verde-a-la-planta-solar-de-puerto-penasco.

61. Moore, Patrick. "Chile Wants to Build an Underwater Cable to Export Energy to Asia. Can It?" Dialogo Chino (blog), January 13, 2022, https://dialogochino.net/en/climate-energy/50155-chile-underwater-cable-export-energy-asia/.

REGIONAL HIGHLIGHTS

Brazil

In 2013, Brazil set a ten-year plan to implement 20 GW of wind power and 3.5 GW of utility-scale solar power by 2023.[62] Data shows that Brazil has surpassed these numbers with 21.5 GW of operational onshore wind power and 5.4 GW of operational utility-scale solar power. The 167 prospective wind farm projects and 182 prospective solar projects in Brazil bode well for meeting the goal of 81 GW of utility-scale solar and wind power by 2030 and 190 GW by 2050.[63] The bulk of this goal may be met by actualizing the 128 GW of prospective offshore wind. Additionally, Brazil has an extensive distributed solar power network that contributes more than 20 GW[64] of renewable energy capacity. In response to climate change, Brazil's solar and wind investments are shifting the energy matrix away from fossil fuels to supplement hydroelectric power to meet the rising demand for renewable electricity in the country.[65] Brazil uses a combination of tools to encourage investment in the solar and wind sectors including subsidized loans for investment, Power Purchase Agreement (PPA) auctions, guarantees for financing, and direct purchasing agreements between private entities.[66] Luiz Inácio Lula da Silva's presidential victory in October 2022 was based on an environmental platform which puts deforestation as the top priority; however, the administration also intends to promote Petrobras' involvement, public investment, and public-private partnerships for offshore wind.[67]

Chile

Historically a net-importer of fossil fuels, Chile is striving to have a 100% renewable energy system by 2030. With extremely high solar irradiation in northern Chile and gusty wind throughout the country, particularly in Patagonia, Chile has a geographic advantage for renewable energy adoption.[68] Chile has the first CSP project in Latin America, Cerro Dominador, and the Chilean government expects that CSP will grow to outpace solar PV, despite concerns about construction time for future CSP.[69,70] Chile's exporting of solar energy to Argentina during the day in exchange for natural gas to power the grid during the night illustrates the barriers Chile faces from a lack of solar energy storage.[71] Chilean President

62. "Renewable Energy in Latin America: Brazil." Norton Rose Fulbright, accessed December 7, 2022, https://www.nortonrosefulbright.com/en/knowledge/publications/b2d19c29/renewable-energy-in-latin-america-brazil.

63. Ellis, James and Natalia Castilhos Rypl. "2030 Brazil Roadmap: Multiplying the Transition." Climate Investment Fund, October 2021, accessed December 2022, https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/bnef-cif_fi_project_2030_roadmap_slide_deck_brazil.pdf.

64. Brazil has 20.7 GW of sub-threshold solar according to the Global Solar Power Tracker and IRENA's Renewable Energy Statistics 2022 dataset.

65. Yang, Muyi and Pete Tunbridge. "Brazil: Wind and Solar are Meeting Brazil's Rising Electricity Demands." Ember, March 2021, accessed December 2022, https://ember-climate.org/app/uploads/2022/02/Global-Electricity-Review-2021-Brazil.pdf.

66. Podestá, Andrea et al. "Políticas de atracción de inversiones para el financiamiento de la energía limpia en América Latina." https://repositorio.cepal.org/bitstream/handle/11362/48084/1/S2200585_es.pdf.

67. Deakin, Arthur. "4 Ways Lula Will Transform Brazil's Energy Sector." Americas Market Intelligence (blog), accessed December 7, 2022, https://americasmi.com/insights/lula-energy-sector-brazil/.

68. "Chile well positioned for green future." en:former, accessed December 7, 2022, https://www.en-former.com/en/chile-well-positioned-for-green-future/.

69. Podestá, Andrea et al. "Políticas de atracción de inversiones para el financiamiento de la energía limpia en América Latina." https://repositorio.cepal.org/bitstream/handle/11362/48084/1/S2200585_es.pdf.

70. Cabello, Luisa. "Desplegar 22,5 GW de renovables y almacenamiento a 2030 en Chile exige planificación." pv magazine Latin America, May 5, 2022, https://www.pv-magazine-latam.com/2022/05/05/desplegar-225-gw-de-renovables-y-almacenamiento-a-2030-en-chile-exige-planificacion/.

71. Ini, Luis. "Strategically Timed, Transnational Exchange of Solar Energy." pv magazine International, accessed December 7, 2022, https://www.pv-magazine.com/2022/11/15/strategically-timed-transnational-exchange-of-solar-energy.

Gabriel Boric has made green policies a central focus of his administration, with a particular emphasis on utility-scale solar in the Atacama region and exploring offshore wind development in Chilean Patagonia.

Colombia

If all prospective utility-scale solar and wind capacity were to come online, Colombia would exceed its goal of adding 4 GW[72] of renewable energy to the grid between 2022-2030 by over 33 GW (25.0 GW of solar and 12 GW of wind).[73] This goal was established before President Gustavo Petro took office in August 2022. Petro, who referred to coal and oil as the world's two main poisons,[74] has promised to speed up the energy transition ("La transición se acelerará.")[75] The 2022 Colombian Green Energy Roadmap shows the country could reach a 100% renewable electric grid by 2030,[76] but it is likely Petro will push Colombia to set a more ambitious target in the May 2023 release of the Just Energy Transition Roadmap. Following COP27, Colombia signed an agreement to develop green hydrogen, solar, and wind with the European Union.[77] With Colombia moving to dramatically decrease the extraction of fossil fuels, there is a need for a clear economic plan on how to replace the revenue from fossil fuel exports.[78]

Mexico

Between the 2013 energy reforms[79] and the López Obrador administration's May 2021 energy reforms,[80] which granted state-owned entities more control and suspended construction permits, utility-scale solar and wind energy projects saw significant growth. Since 2021, however, the pro-fossil López Obrador administration policies have slowed down renewables growth, helping to explain why Mexico hasn't kept up with the utility-scale solar and wind growth rates of Brazil, Chile, and Colombia.[81] However during COP27, Mexico pledged to add 40 GW of new solar and wind projects by 2030.[82] If all the prospective projects in Mexico come to fruition, the country will still need to add 11 GW of utility-scale solar and wind to reach its pledge. The trend of renewable projects becoming shelved, mothballed, or canceled (a total of 11.6 GW) illustrates the difficult development conditions in the country, including legal challenges and lag times for

72. Black, Thomas and Jairo Gutierrez, "Renewable Energy Auctions Support Colombia's Climate Targets." Climate Links, January 13, 2022, accessed December 12, 2022, https://www.climatelinks.org/blog/renewable-energy-auctions-support-colombias-climate-targets.

73. This includes 4.6 GW of capacity in Colombia slated to come online in 2032.

74. "Ante la ONU, Petro Afirmó que el Carbón y del Petróleo son 'Los Dos Principales Venenos del Mundo'." *Info Bae*, September 19, 2022, accessed January 30, 2023. https://www.infobae.com/america/colombia/2022/09/20/ante-la-onu-petro-afirmo-que-el-carbon-y-del-petroleo-son-los-dos-principales-venenos-del-mundo/.

75. Sánchez Molina, Pilar. "El Nuevo Presidente de Colombia Visita Granjas Solares y Las Pone Como 'Ejemplo a Seguir'." *PV Magazine*, August 18, 2022, accessed January 31, 2022, https://www.pv-magazine-latam.com/2022/08/18/el-nuevo-presidente-de-colombia-visita-granjas-solares-y-las-pone-como-ejemplo-a-seguir/.

76. "Hoja de Ruta: Electricidad 100% Renovable en Colombia a 2030." Grupo de Investigación EADE, August 2022, accessed December 2022, https://tubcloud.tu-berlin.de/s/7WfLc6QjC47EnDC.

77. "Colombia Inks Clean Energy Accord with Europe." BNamericas.com, accessed December 7, 2022, https://www.bnamericas.com/en/news/colombia-inks-clean-energy-accord-with-european-investment-bank.

78. Rubiano A., Maria Paula. "How Colombia Plans to Keep Its Oil and Coal in the Ground." BBC Future, accessed December 7, 2022, https://www.bbc.com/future/article/20221116-how-colombia-plans-to-keep-its-oil-and-gas-in-the-ground.

79. "Diario Oficial de La Federación." accessed December 7, 2022, https://dof.gob.mx/nota_detalle.php?codigo=5327463&fecha=20/12/2013.

80. Tapia Cervantes, Patricia. "Reforma Eléctrica de AMLO Frena al Sector Energético: Moody's." Forbes Mexico, October 6, 2021, accessed January 25, 2023, https://www.forbes.com.mx/negocios-reforma-electrica-amlo-frena-sector-energetico-moodys/.

81. Sánchez, Axel. "Crece 63.1% Generación de las Carboeléctricas." Milenio, January 30, 2023, accessed February 1, 2023, https://www.milenio.com/negocios/crece-63-1-generacion-de-las-carboelectricas.

82. Dlouhy, Jennifer. "Mexico Pledges to Add 40 Gigawatts of New Clean Energy Generation," accessed December 7, 2022, https://ieefa.org/articles/mexico-pledges-add-40-gigawatts-new-clean-energy-generation.

approving projects.[83] Conversely, the 2021 reforms triggered an uptick in fossil investments. Indeed, according to the Global Gas Plant Tracker, Mexico has 13.3 GW of prospective gas projects, nearly double its prospective utility-scale solar and wind projects combined (6.7 GW). While the López Obrador administration uplifts policies favoring Federal Electricity Commission (CFE)-owned fossil fuel power facilities, it is unlikely that prospective utility-scale solar and wind will increase as non-CFE development interest and foreign investment are curtailed by legal barriers.

Argentina

Argentina has abundant renewable energy resources but has not yet taken the strides to turn utility-scale solar and wind into reliable power sources. Argentina's Renewable Energy Auction (RenovAr) program, with a 10 GW goal for renewables by 2025, is not on track.[84] Potential strategies to increase the speed of renewable energy uptake include reallocating Argentine state subsidies to promote solar and wind energy projects.[85] The initial investment costs to enhance renewable energy in Argentina would be the least costly path (compared to waiting to pursue new renewable projects) for meeting electricity demands by 2050.[86] The path through the energy transition will need to be led by an administration willing to increase state spending on solar and wind.

Peru

Peru is focusing on transitioning the energy grid to renewable sources by investing in appropriate infrastructure, incentivizing sustainable practices, and developing the industry to become exporters of green hydrogen.[87] Energy investments have managed to keep projects developing in Peru despite recent political turmoil.[88] If Peru can achieve political stability, it will be more attractive to investors, and the pace of growth may increase.

Island Nations

While the majority of renewable energy on the Caribbean islands is distributed solar, some islands are growing their utility-scale solar and wind capacity in order to enhance their energy security.[89] Scaling up renewable energy throughout the Caribbean requires an increase in both public and private financing.[90] Barbados, Cuba, the Dominican Republic, Jamaica, Puerto Rico, and Trinidad and Tobago each have at

83. "'There Is a Tremendous Opportunity' in Mexico's Renewables Sector." BNamericas, accessed December 7, 2022, https://www.bnamericas.com/en/interviews/there-is-a-tremendous-opportunity-in-the-mexican-renewables-sector.

84. Reingold, Julián. "Argentina's Troubled Road Towards Green Hydrogen." Energy Monitor, accessed December 7, 2022, https://www.energymonitor.ai/tech/hydrogen/argentinas-troubled-road-towards-green-hydrogen.

85. Bauza, Vanessa. "Un Nuevo Amanecer: Argentina Aprovecha Su Potencial de Energías Renova." accessed December 7, 2022, https://www.ifc.org/wps/wcm/connect/NEWS_EXT_CONTENT/IFC_External_Corporate_Site/News+and+Events/News/Argentina-taps-into-its-renewable-energy-potential-v_Spanish.

86. Keesler, Daniela, Nicolás Díaz Almassio, and Gabriel Blanco. "A Comparative Costs Analysis of the Energy Transition in Argentina." n.d., 53 https://periodistasporelplaneta.com/wp-content/uploads/2021/10/Analisis-comparativo-de-costos-para-la-transicion-energetica-en-la-Argentina.pdf.

87. "Hoja de Ruta de Transición Energética." Enel.Pe, accessed December 7, 2022, https://www.enel.pe/es/sostenibilidad/transicion-energetica-peru-2050.html.

88. Rochabrun, Marcelo. "Analysis: Years of Political Crises in Peru Are Finally Hitting Its Economy." Reuters, accessed December 7, 2022, https://www.reuters.com/world/americas/years-political-crises-peru-are-finally-hitting-its-economy-2022-08-18/.

89. Vogt, Martin. "The Caribbean's Untapped Renewable Energy Potential." accessed December 7, 2022, https://www.renewableenergyworld.com/storage/the-caribbeans-untapped-renewable-energy-potential.

90. Burunciuc, Lilia. "Clean Energy in the Caribbean: A Triple Win." accessed December 7, 2022, https://blogs.worldbank.org/latinamerica/clean-energy-caribbean-triple-win.

least 100 MW of prospective utility-scale solar and wind projects.

The Dominican Republic has seen significant investments in utility scale renewables because of a 2007 law providing financial incentives for foreign investors in clean energy projects.[91] Among island nations, the Dominican Republic has the most prospective utility-scale renewables with 100 MW of wind and 2,165 MW of solar. In 2022, the Dominican Republic had approximately 5 GW of installed generation capacity from all fuel sources. Therefore, if all of the prospective renewable projects come online, the island will be well positioned to reach its goal of generating a third of its energy from renewable sources by 2030.[92]

Central America

While Central America's Central American Electrical Interconnection System (SIEPAC) is already in place, additional regional planning is still required to prepare for future renewable energy growth; solar and wind energy development on a utility-scale will require adequate transmission and distribution grids to optimize regional power system integration.[93] Panama is the standout leader in Central America with 2,468 MW of prospective projects (1,152 MW wind and 1,316 MW solar). Panama's success in attracting utility scale projects can be attributed to a generally positive business environment, tax incentives for clean energy projects since 2004,[94] and the use of the national COVID-19 recovery strategy as an opportunity to focus on the 2030 energy transition agenda.[95]

DATA GAPS AND FUTURE RESEARCH

Updates are made to the Global Wind Power Tracker and the Global Solar Power Tracker once a year. As a result, both trackers may be missing projects that meet their corresponding thresholds at the time of publication. Additional projects will be added for the next release of the trackers, which is scheduled for December 2023. Distributed solar installations, off-grid solar installations, and even sub-20 MW grid-connected utility-scale solar installations are common and amount to roughly 65% of all global solar power capacity.[96] A complete picture of the region's current and prospective solar capacity would include solar projects with capacities that fall below the Global Solar Power Tracker's threshold for inclusion.

91. "Law 57-07 on Incentives for Development of Renewable Energy Sources and Its Special Regimes – Policies." IEA, accessed December 7, 2022, https://www.iea.org/policies/5290-law-57-07-on-incentives-for-development-of-renewable-energy-sources-and-its-special-regimes.

92. Silverstein, Ken. "The Dominican Republic Is Going Green To Boost Tourism And Energy Security." accessed December 7, 2022, https://www.forbes.com/sites/kensilverstein/2022/10/03/the-dominican-republic-is-going-green-to-boost-tourism-and-energy-security/?sh=689b250e2d5b.

93. "Renewable Energy Roadmap for Central America: Towards a Regional Energy Transition." accessed December 7, 2022, https://www.irena.org/publications/2022/Mar/Renewable-Energy-Roadmap-for-Central-America.

94. "Climate Impacts on Latin American Hydropower," n.d., 60; "Climatescope 2022 | Panama." accessed December 7, 2022, https://global-climatescope.org//markets/pa/.

95. Kessler, Richard. "'We Want to Strengthen Our Commitments': Panama Energy Secretary Targets Faster Transition." Recharge, May 20, 2021, https://www.rechargenews.com/wind/we-want-to-strengthen-our-commitments-panama-energy-secretary-targets-faster-transition/2-1-1013027.

96. Source: Bloomberg Finance L.P., 2020.