Latin America PV Playbook

Q4 2016 Market Update – Executive Summary

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About the Author

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Manan Parikh is a Solar Analyst for GTM Research covering the downstream Latin American markets. Prior to GTM, his work has been extensively research based, centering upon alternative fuels infrastructure development and Low Carbon Fuels Standard (LCFS) policy models for the Schatz Energy Research Center and UC Berkeley in Northern California. In California, he was also an ambassador to start-up teams within the Clean Tech Open accelerator as well as a consultant to DOE SunShot Catalyst Award winner, PVComplete. In Washington, DC he worked on biomass policy at the American Council On Renewable Energy. He is an alumnus of The University of Texas at Austin, where he graduated with a B.S. in Biochemistry.

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Glossary of Terms and Acronyms

ACESOL: Chilean Solar Energy Association

ANEEL: Brazilian National Electricity Agency

BNDES: Brazilian National Bank for Economic and Social Development

CAGR: Compounded Average Growth Rate

CAMMESA: Wholesale Power Market Administrator, Argentina

CapEx: Capital expenditures

CCEE: Electric Energy Trading Chamber, Brazil

CDEC: National Electric Coordinator, Chile

CEL: Clean Energy Certificate, Mexico (1 CEL = 1MWh)

CFE: Federal Electricity Commission, Mexico

CENACE: National Center for Energy Regulation, Mexico

CNE: National Energy Commission, Chile

COD: Commercial Operation Date

CREG: Energy Regulatory Commission and Gas

C&I: Commercial and Industrial

DAC: Large residential consumer tariff class, Mexico

DC: Direct Current

EMGESA: Second largest generator in Colombia

EPE: Energy Research Company, Brazil

FODER: Government-funded renewable energy fund, Argentina

H-M: Industrial tariff class, Mexico

ICMS: Tax Operations related to goods and interstate transport, Brazil

IDB: Inter-American Development Bank

IPP: Independent Power Producer

IRENA: The International Renewable Energy Agency

LCOE: Levelised cost of electricity

NEM: Net Energy Metering

OECD: Organization for Economic Co-operation and Development

O-M: Industrial tariff class, Mexico

PMGD: Small-to-medium DG projects, Chile

PPA: Power purchase agreement

RenovAR: Renewable Energy Plan, Argentina

SADI: Argentina Electric Sector

SENER: Energy Secretary, Mexico

SIC: Central Interconnected System, Chile

SIEPAC: Electric Interconnection System for Central American Countries

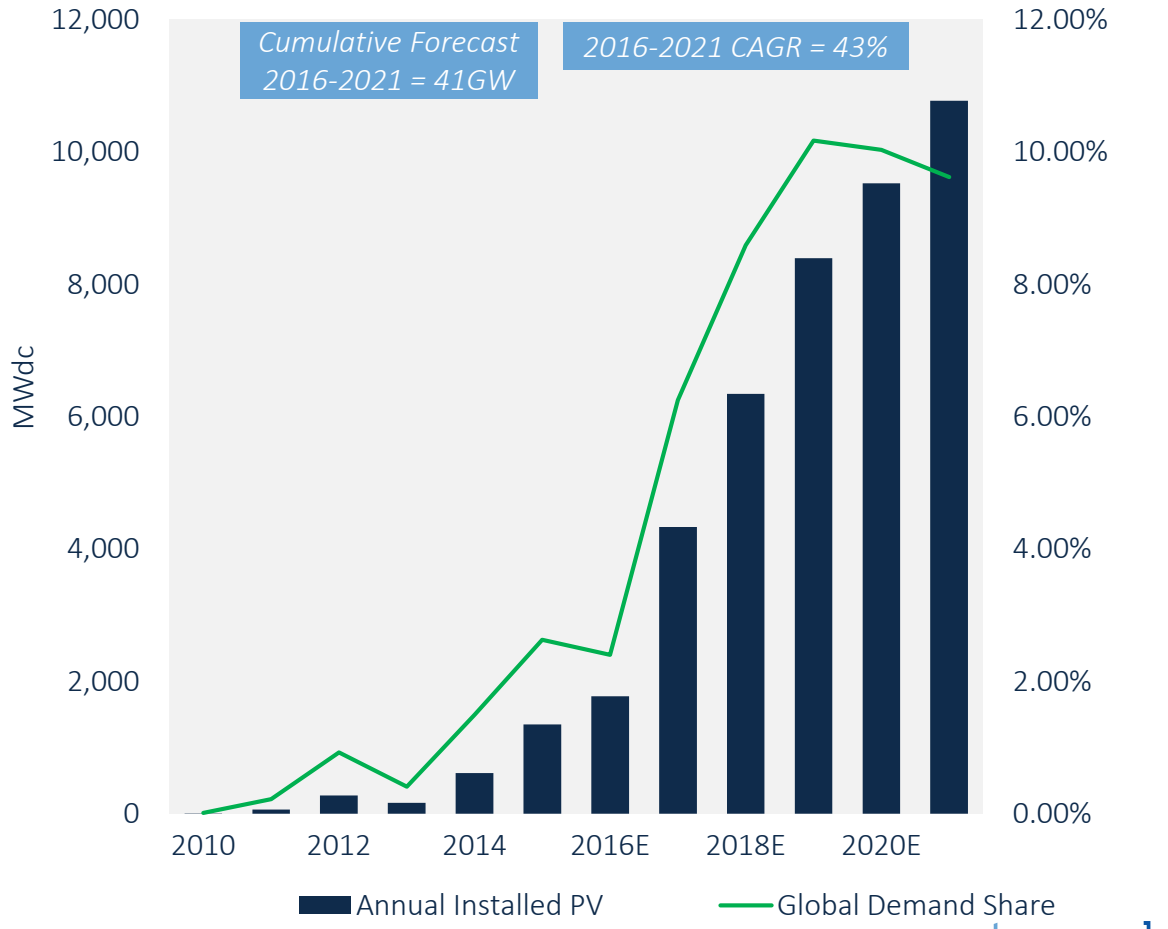
SING: Northern Interconnected System, Chile

UPME: Mining and Energy Planning Unit, Colombia

1. Executive Summary

Latin America Summary: Global share of PV demand increases by 4% in 2017 adding 4 GW

Latin America PV Demand 2010-2021E



Source: GTM Research *Global Solar Demand Monitor Q4 2016*

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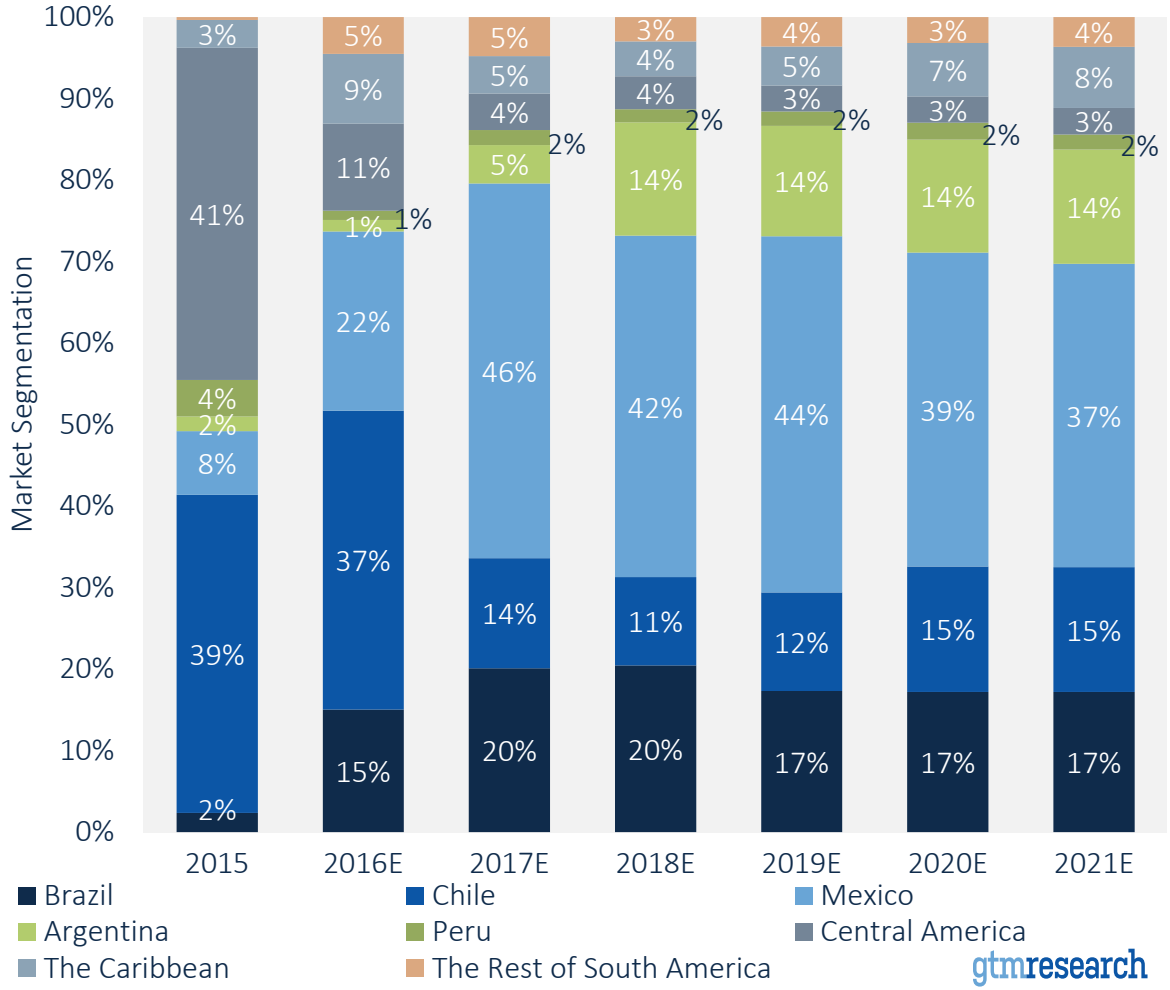
- Latin America is expected to significantly increase continues to increase its share of PV demand. The region as a whole is expected to take over 6% of global PV demand in 2017 on the basis of strong growth in several major markets such as Mexico and Chile. Several key markets on the rise include Argentina and Colombia, with regional giant, Brazil, capable of becoming a force once again through economic recovery.
- Utility-scale solar leads all other segments of PV in across the region where solar is beating out prices for other technologies in auctions, and capturing much more of the market share for non-conventional renewables. In the second half of 2016, solar prices reached a low for not only Latin America, but briefly globally at $29/MWh during Chile's August national supply auction. Distributed generation is on the rise, in some markets such as Mexico and Brazil, where net metering and other incentives are in place.
- Investment in the sector is spurred through the introduction of tax reforms, partnerships with development banks and funds for renewable-specific projects. Due to low PV prices, however, financing for low rate of return projects is one of the most challenging endeavors for developers. Still, economic recovery and corresponding growth in power demand helps sustain regional renewable energy investment in 2017.
- Causes for concern in several markets include currency depreciation (Mexico and Brazil) to ever-present political changes. Latin America electricity consumption per capita is still relatively low when compared with OECD countries. The IMF revised growth projections for Latin America and the Caribbean downwards to 1.2% in 2017, with weaker than expected GDP gains in the major markets of Brazil, Chile, Mexico and Argentina.

Argentina and Colombia are poised to cut into the Big Three's share of LatAm PV demand

Latin American Markets' Share of Annual Regional PV Demand 2015-2021E

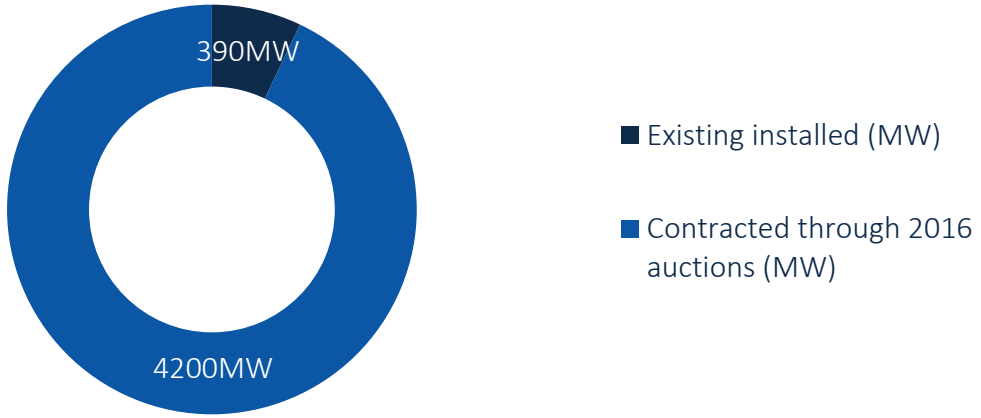


Highlights:

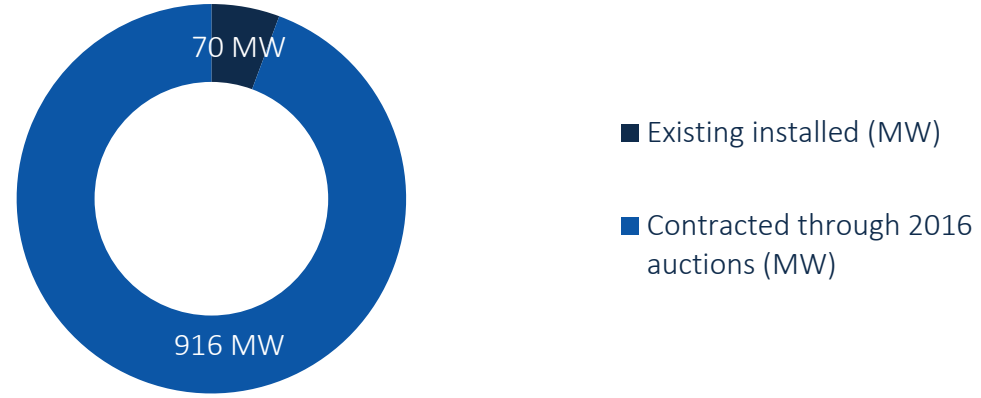
- Argentina's auction clears the way for almost 1 GW of PV to contract through the RenovAR program – a vehicle which establishes targets and ways for clean energy to flourish in the country out through 2025 – when the country has an 20% target for renewables generation. RenovAR Ronda (Round) 2 will be unveiled as soon as March to start the process for more projects to be added on beyond 2018.
- Colombia is somewhat following the footsteps of several of its LatAm neighbors. Because Colombia only operates under private utilities, many PV projects are for self consumption only without proper incentives such as net metering. As of the most recent energy expansion roadmap, only 150 MW of solar was targeted by 2035, but that number should be surpassed by 2018 alone.
- Mexico will spend 2017 getting started on the massive 4.2 GW pipeline issued in 2016. Projects are being signed, sited, and seeking financing but the continuing decline of the Peso is hurting confidence in whether project returns will be high. System components are sourced in dollars but compensation will be in MXN.
- Chile continues to be the leader of cumulative PV installed in Latin America. Chile will experience a down year in 2017, and cede it's top standing. Projects wait to connect to an already congested grid, but Chile adds a few more > 50MW projects to the grid.
- Brazil may be largest economy in Latin America, but a recession and excess electricity supply clouds PV's future development past already contracted projects.

2016 in Review: Mexico and Argentina breakout onto the scene; Brazil cools off

Mexico 2016 auctioned pipeline is a 1000% increase in the PV market



Argentina 2016 auctioned pipeline is a 1300% increase in the PV market



2016 was the year of utility-scale auction surprises:

- Both Mexico and Argentina's auctions surprised and exceeded expectations in 2016, signaling the first stage for promising build out.
  - In **Mexico**'s case, there was doubt whether the proposed energy transition would pan out to the benefit of solar – especially for the utility scale. Before the first energy auction in March, there were many differing views as to whether PV would be able to compete with other energy sources like wind and natural gas. These reservations proved to be overblown as PV emerged as the overwhelming winner in both utility auctions totaling 4.2GW of capacity at prices as low as $33/MWh.
  - **Argentina** was an absolute wildcard factoring into the overall dynamics of regional PV. President Macri showed signs of reviving an aging and uncompetitive sector when he was elected in late 2015, but the swiftness of the changes to the sector were unexpected. In total, through 2 rounds of auctions, Argentina added close to 1 GW of utility scale PV. It was, however, the introduction to financing and renewable energy targets in 2016 which set solar up for success in the long term.
- The largest economy in the region, **Brazil**, fell victim to several macroeconomic factors from political instability to drought. These factors decreased the overall electricity demand year over year by 0.7%, and was the main driver for the cancellation for both planned 2016 auctions for which solar was to be a part of. Almost 700MW of tendered projects from 2014 remain in flux after a potential cancellation plan was scrapped.

2017 Regional Trends: Expect solar's momentum from 2016 to carry over

Latin America Major Markets' PV Projections

Brazil

Outlook: Weak

- Brazil was unable to catch a break in almost every facet of the market in 2016. Expect 2017 to be a rebound year for PV as the economy grows incrementally.
- It is also expected that ANEEL has factored in the regular ebb and flow of hydro capacity when planning future supply auctions.
- Utility-scale solar's loss will be distributed generation's gain. Expect especially the C&I segments add another 50-80MW.

Chile

Outlook: Neutral

- The most recent CNE supply auction, actually turned out to be a gain for PV.
  - Developers shrewdly worked around the block bidding structure to secure generation in the 24 hour slots using other technologies as a front for a portion of the project to be solar. Expect the cat-and-mouse game to continue.
- Look for SIC-SING interconnection to spill progress into early to mid 2018.

Mexico

Outlook: Strong

- Recent auctions masked the expiration of permits from the old scheme. A flurry of end of 2016 will upward of 500MW additional permitted capacity.
- Auctioned projects are now in the financing stage, one that will not an easy hurdle to clear given the low rates of return calculated on some projects.
- Installers have capitalized on the DAC tariff clients, but rates in O-M and H-M industrial classes are increasing too. Look for most of the 2017 DG installations to take place in this class.

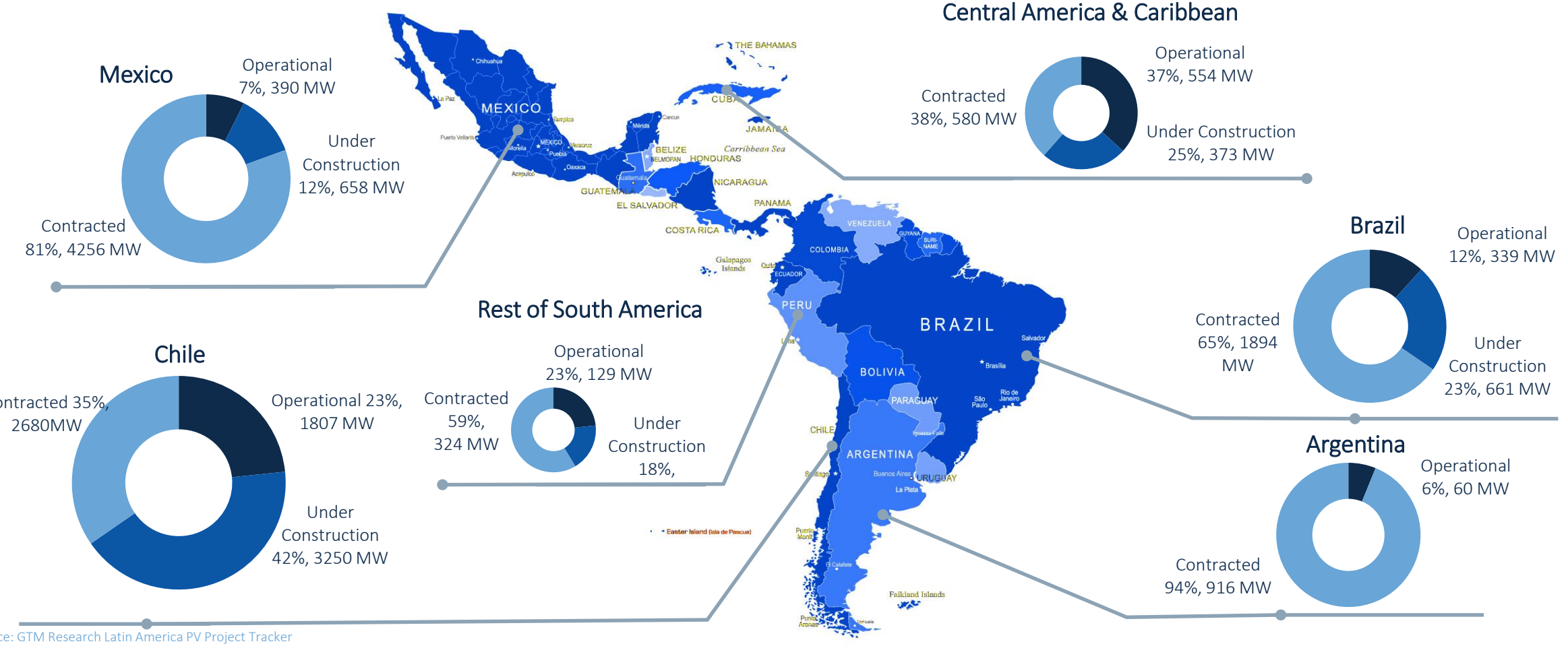
Colombia & Cuba

Outlook: Rising

- Thawing of international relations has provided a spike in the interest of developing renewables on the island. The completion of a 50MW utility plant and 100MW auction will lead to more interest pouring into the country given its demand needs.
- Colombia can be pegged as the new Argentina, with a more stabilized government and need for cleaner and cheaper energy sources. Colombia, however, faces policy and incentive limitations.

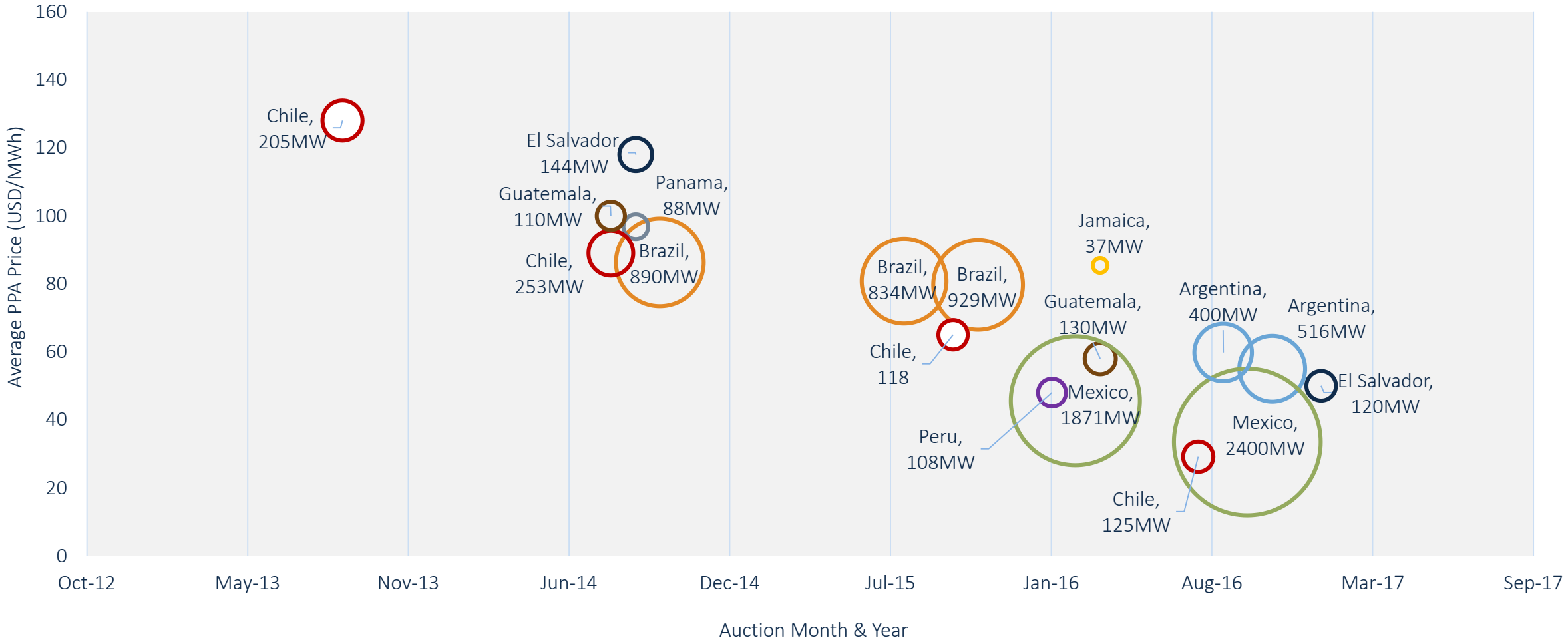
Executive Summary: Chile races past 1GW; Mexico now has the largest contracted pipeline

Regional Project Pipelines (MW_{dc})



Source: GTM Research Latin America PV Project Tracker

Latin America's Auction History Shows Declining Price Trend Over the Past 4 Years



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