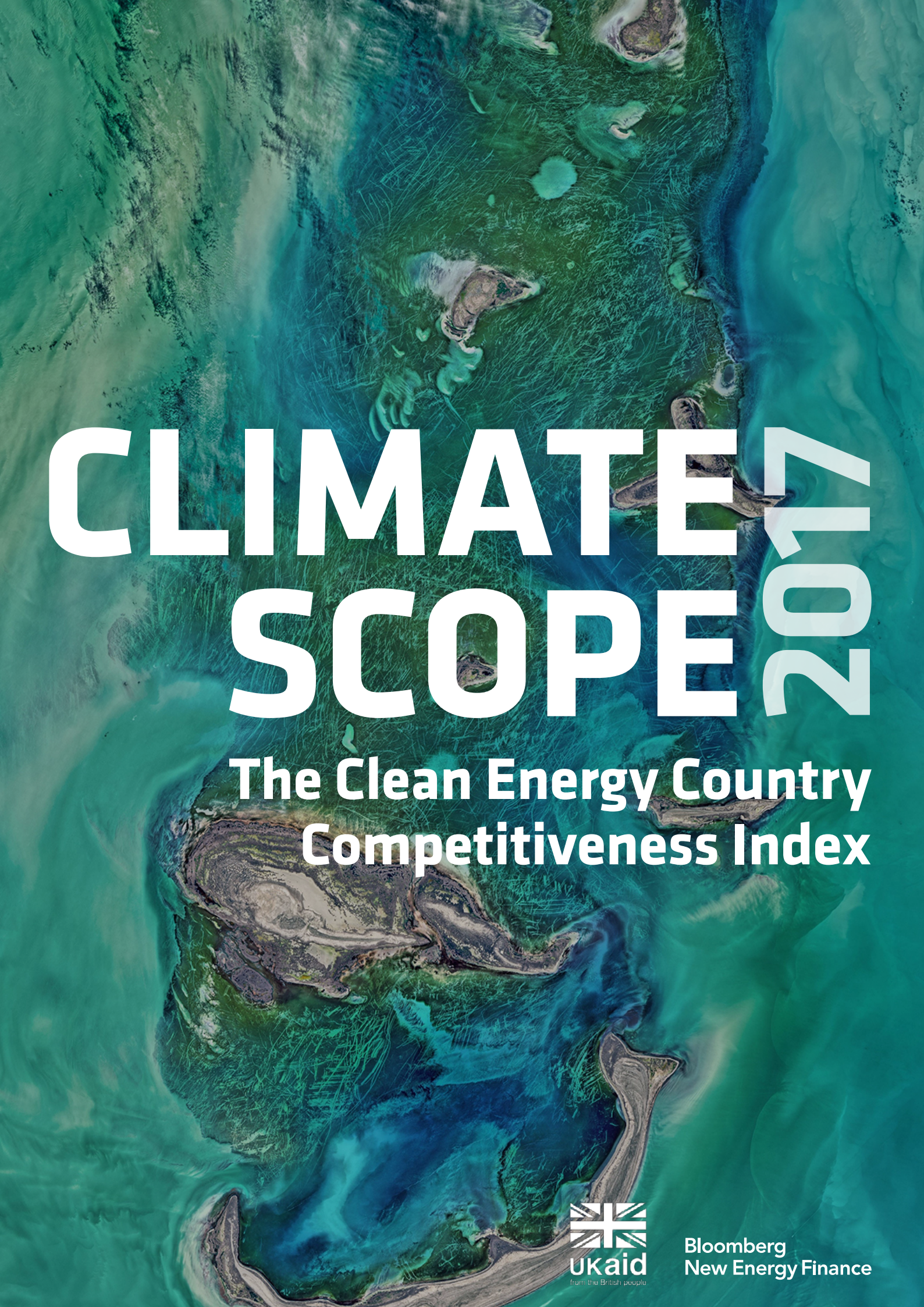

CLIMATE SCOPE 2017

The Clean Energy Country Competitiveness Index

UKaid
from the British people

Bloomberg
New Energy Finance

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Section 1. Overview

Each year, Climatescope takes stock of clean energy activities across the world's developing nations. This year, the survey has been expanded to cover 71 nations. Among them, this group accounts for 32.5% of global GDP and 72.4% of global population.

Collectively, developing nations represent both the greatest challenge and greatest hope in addressing global warming. On the one hand, these countries will account for virtually all future CO2 emissions growth thanks to their rapidly expanding economies. They also stand to suffer disproportionately from major weather events and temperature rises as they often lack infrastructure and resources to adapt. On the other hand, they offer some of the best opportunities for clean energy development. Many are home to outstanding natural resources, high prices for incumbent energy, and millions of citizens justifiably seeking improved energy access.

Since first being published in 2012, Climatescope has generally chronicled how hope and clean energy opportunities are triumphing over pessimism and challenges in developing countries. Trends decidedly in renewables' favor have included: low interest rates in OECD countries and wide capital flows; rapidly falling clean energy equipment costs and the associated improving economics; and the strengthening of national and local policy frameworks.

Climatescope 2017, however, includes some troubling results highlighting serious obstacles to clean energy scale-up in developing nations. These come just two years after the historic agreement in Paris where no less than 200 nations pledged to address climate change, and eight years after Copenhagen where the world's wealthiest nations promised to deliver $100 billion per year by 2020 to assist poorer countries address climate change. Specifically, Climatesope's high-level findings include:

- Total new clean energy asset (project) investment in non-OECD countries fell by $40.2 billion, or 27% in 2016 from the year prior to $111.4 billion. While China accounted for three quarters of the decline, new clean energy investment in all other non-OECD countries fell by a similar 25% from 2015 levels.
- Clean energy investment is concentrated in a relatively small number of nations. Only 16 countries in the survey saw total investment rise year-on-year; 18 saw investment fall. 37 countries saw no clean energy investment at all in 2016.
- Foreign capital continues to play a critical role in the emerging markets clean energy scale-up but wealthier nations scaled back their support in 2016. After growing from $2.7 billion in 2007 to $13.5 billion in 2015, OECD to non-OECD funding for clean energy fell by 26% to $10 billion in 2016. Funds awarded specifically from development banks have essentially stagnated at approximately $4 billion since 2014.
- Total new capacity built in 2016 fell from the prior year as well but at a less precipitous rate. A total of 60.7GW of wind, solar, small hydro, geothermal, and biomass projects were commissioned in Climatescope countries in 2016, down from 67.4GW in 2015. Excluding China, however, total capacity additions rose in Climatescope countries to a record 16.8GW in 2016 from 12.3GW in 2015.
- For the first time ever, Climatescope nations installed more solar than wind capacity. Solar capacity additions jumped 50%, from 22GW in 2015 to 34GW in 2016. However, wind installs fall by half, from 38GW in 2015 to 19GW in 2016.

- Nearly every Climatescope country was a Paris signatory. Fourteen pledged to cut emissions in absolute terms, seven to reduce them in terms of intensity, and 33 to allow them to rise but at a slower pace than under a business-as-usual scenario. Seventeen made no emissions-specific promises at all.
- Ten countries offered single commitments they promised to meet unconditionally. 19 said their commitments were conditional on wealthier nations providing financial assistance. 25 offered both unconditional and conditional promises. But two years since Paris, just 13 nations surveyed have actually implemented any domestic laws to limit emissions.

Climatescope is a detailed, country-by-country quantitative assessment of clean energy market conditions and opportunities in 71 nations in South America, Europe, Africa, the Mideast, and Asia. Based on 43 data indicators and 179 sub-indicators, Bloomberg New Energy Finance determines scores for each nation in the survey on a 0-5 basis. All countries are then ranked. (For more on how the scores are derived, please see the complete methodology and results in Excel format). Key country-score findings:

- For the first time since Climatescope was launched four years ago, the average country score fell year-on-year. Nations sampled collectively scored 1.35 in last year's survey (out of 5). That average fell to 1.19 this year, though the figure was skewed somewhat with the addition to the survey of 13 new nations from Central Asia and Europe. All but two of the 13 new countries are former states of the Soviet Union with aging energy infrastructure and little renewables activity to date.
- Comparing the same 58 nations sampled last year with those from this year still produced a drop in the average score, to 1.25. Just 12 countries from this smaller group saw their scores rise year-on-year while 44 saw declines (two were unchanged).
- As in years past, no country managed a score higher than a 2.5. Even among the best-performing countries, scores declined. Seven of the top 10 ranked nations scored lower this year than in the prior survey. At the other end of the spectrum, the lowest single score in the survey fell from 0.3 in the last survey to 0.2 this year. A total of just four countries scored over 2.0 this year, down from 10 nations the year prior.
- China topped the survey again with a score of 2.5, almost the same as last year. The country remains the world's single largest market for clean energy development, but saw new asset (project) investment fall by $36.6 billion year-on-year. As 2015 was the end of the 13th Five-year plan, project developers slowed new investment in 2016 as they awaited changes to clean energy policies, including significant reductions in feed-in tariffs, adjustments to land-use and other mechanisms. Meanwhile, China's current fleet of wind and solar projects faces serious curtailment issues.
- The top 10 highest scoring nations this year consist of three from Asia (China, India, and Vietnam), four from the Latin America/Caribbean region (Brazil, Mexico, Chile, and Uruguay), two from Africa (South Africa and Kenya), and one from the Middle East (Jordan).
- Despite the overall downward trend in the scores, there were some notable achievements.
  - Senegal's score jumped 0.59 to 1.68 after successfully executing a tender for clean energy supply contracts in 2016 and improving the credit-worthiness of its utility.
  - Egypt made key changes to its existing feed-in tariff scheme and has set clear clean energy goals which boosted the country's Climatescope score 0.44 from last year and moving it up 23 slots to 19th in the survey.

- Argentina, under a new president, is actively seeking to rebuild foreign investor trust through the establishment of a new Trust Fund for renewables and by setting short-terms goals for adding capacity. The country rose six spots in the 2017 Climatescope rankings.

There is no single reason why investment dropped, deployment levels slipped, and Climatescope scores overall have declined in this latest edition of the survey. Clearly, there has been some stagnation in the creation and implementation of new state-level policies. But in addition, a confluence of factors appear to be at play.

To examine these in a bit greater depth, it is worth considering this group of 71 developing nations in three categories:

- The *Slow-Starters*: These are countries that have done relatively little to encourage clean energy development to date for any number of reasons. These might include the availability of local fossil resources, a lack of awareness or funds and general political instability. Many of the 26 nations that scored below 1.0 in the survey this year fall into this category. All signed the Paris Agreement; few have done anything to carry out the pledges they made through active domestic policy-making in support of clean energy. This year, the list includes Zimbabwe, Malawi, Venezuela, and Paraguay, among others.
- The *Capacity-Builders*: These nations have been actively building policy frameworks or otherwise attempting to roll regulations that either are showing results or could soon do so. In some cases, these countries have seen mini-booms of clean energy activity already. Generally, they score in the 1-1.5 range. Among the 28 nations in this bucket this year are Argentina, Barbados, and Ethiopia. Each is poised potentially to see its score rise in coming years.
- The *Ceiling-Hitters*: These nations have taken many of the correct policy steps to attract investment successfully. Most are among the 10 nations that scored 1.75 or higher in this year's survey. A meaningful number of countries in this group have seen activity actually stall due to larger structural issues related to their power sectors. This group includes Uruguay, South Africa, and Tanzania.

The first two groups above have been common in prior Climatescope surveys. The *Ceiling-Hitters* represent a somewhat new phenomenon, however. Ironically, their very existence reflects the successes clean energy has achieved to date. The greater scale the industry achieves, the more it encounters (and in some cases, compounds) inherent risks in power markets.

Some of the most basic risks involve markets that have simply been overbuilt, at least in the short run. Given its massive size, China is the most noteworthy example of this. The country's fleet of power generators is by far the largest on earth and capable of producing far more power than even China's rapidly growing economy can consume today. The result: the average output (capacity factor) of power plants in China has been declining. For renewables, that has meant that substantial portions of wind and solar generation have recently gone un-consumed due to transmission constraints or because they have been de-prioritized compared to rival coal plants. Chile and most recently India have seen somewhat similar stories.

Clean energy faces other risks associated with scale as well. Reverse auctions, or tenders, specifically held to solicit new clean energy delivery contracts have been a boon for wind and solar developers, allowing them to demonstrate the cost-competitiveness of these technologies. Such contracts typically are de facto government-mandated marriages between developers and state-owned utilities who are required to buy power at winning bid prices.

The PPAs generally require developers to bring projects on line at some future date, typically 2-5 years from signing. In the interim, the developer must secure financing and equipment at sufficiently low cost to ensure the project can earn an appropriate rate of return. But developers face exogenous risks as well associated with the utilities they intend to sell their power to.

These "off-taker risks" take a variety of forms and are inherently tied to larger political risks in any country. This is because the credit-worthiness of state-owned utilities is generally tied to the stability and creditworthiness of the governments who back them. In some cases, the risk posed by the off-taker can be as simple as the utility delaying actual signing of a PPA, despite essentially being directed to do so by the government. In others, the utility's ability to pay its bills may be so in doubt that a project developer cannot secure the requisite project financing.

Other risks associated with achieving scale have become more prevalent as well. In Western Europe and some parts of the U.S., developers regularly encounter not-in-my-backyard opposition from local citizens. But NIMBY-ism is hardly unique to wealthy nations. As developers seek to develop ever larger wind and solar projects requiring larger swathes of land, they are increasingly facing local objections in places such as Mexico, Kenya, and elsewhere.

Some of these risks have been prevalent for years but have become larger obstacles in the past few years. Others are essentially new. Most have been exacerbated by the fact that energy is starting to achieve real scale, a fact reflected in this year's Climatescope tally. No less than seven of the 10 highest scoring nations in the survey saw their scores decline from last year. In last year's version of the survey, each member of the top 10 boosted its score from the year prior.

What is perhaps most disconcerting about the obstacles that are confronting clean energy in the *ceiling-hitter* nations is that these are by no means unique to renewables. Rather, they are emblematic of more fundamental challenges to building large-scale infrastructure of nearly any sort in less developed nations. This suggests that fixes to these obstacles may not come easily.

Still, there are signs that some of these nations are taking important steps to address issues that have served to slow development. In China, which has seen some of the most severe wind/solar curtailment, regulators are designing various mechanisms to reduce renewable curtailment and rapidly spending billions to expand high-voltage transmission capacity, for instance. We now anticipate a bumper year of 2017 new energy investment and 2016's decline may ultimately be remembered as the result of short-term policy uncertainty. More such efforts will doubt be required in coming months if clean energy's momentum from 2010-2015 is to be regained.

Important Progress Off the Grid

While large-scale renewables are encountering some growing pains, the opportunities for smaller-scale clean energy applications widened in 2016. Indeed, the potential for clean distributed sources to expand energy access to millions, potentially even billions, is becoming more apparent every day.

Specifically, the use of solar technologies in micro-grids, pay-as-you-go battery/lantern systems, water pumps, and even mobile phone towers continues to proliferate. Often, these deployments flourish organically, unencumbered by government oversight and supported by impact and venture capitalists rather than by traditional funding sources such as development finance institutions. Instead, a wave of socially-oriented entrepreneurs have taken the lead, securing financing from private sources and forging partnerships with large corporates such as telecom providers.

At the most basic level, sales of solar-powered lanterns and similar devices intended for use in huts and other small dwellings have been surging. The Global Off-Grid Lighting Alliance (GOGLA), Lighting Global and Berenschot track the sale of portable solar equipment and found approximately 510,000 such units were sold in 2011. By 2014, that had risen to 5.7 million and in 2016 it topped 8 million. The actual volume of such solar equipment sold could be larger yet as much of what gets distributed today is not tracked.

In India, the number of solar irrigation pumps installed more than doubled from the country's 2015 fiscal year to more than 43,000 units in 2016. Strong mobile network coverage, improving education/training and access to digital supply chains have helped some of the larger emerging markets nations secure substantial venture capital investment. Specifically, Indonesia attracted $1.9 billion and Nigeria $839 million in 2016. Finally, there are signs that electrification rates are creeping up with countries such as Peru, Nepal, Indonesia, and Sri Lanka all leading the way.

Even independent off-grid power sector players encounter hindrances, however. State-run utilities are not necessarily enthusiastic about their activities and in the worst cases can regard them as rivals to potential expansions of the hub-and-spoke grid. Governments regularly complain that micro-grid power tariffs do not match those offered by the state-run utility.

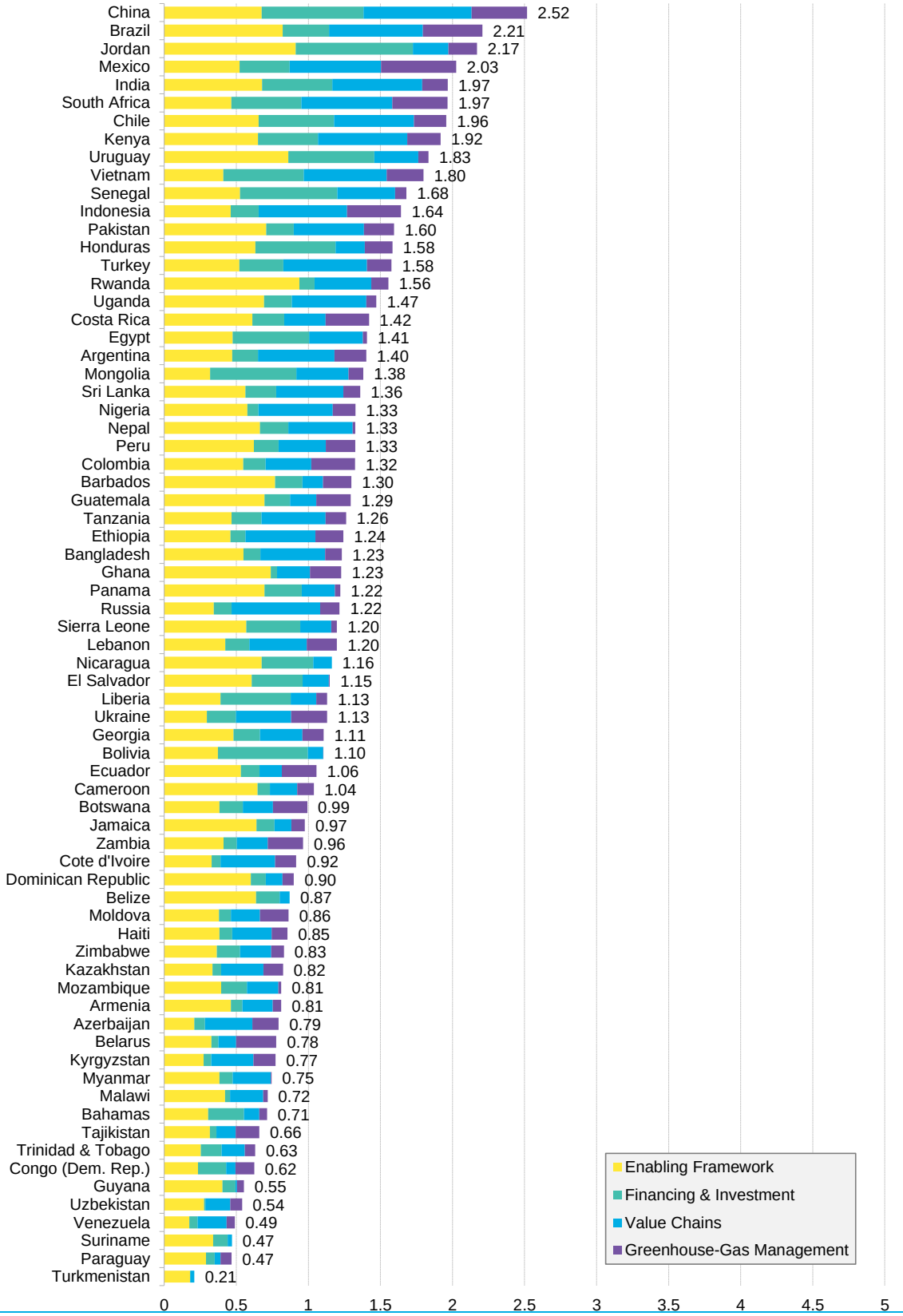
None of these issues stands to be resolved entirely in the short-term but there have been recent positive examples of policy-makers seeking to foster organized growth of off-grid supplied power. Rwanda's Electricity Access Rollout Program (EARP), for instance, seeks to dramatically boost electricity access in the country to 70% by June 2018 from just 30% as of May 2017. While that ambitious target will likely be difficult to achieve, the program already has shown results; Rwanda's electrification rate jumped from 20% in 2015 to 30% to 2016. The government now plans to hold a tender to contract a single firm to distribute PV systems en masse to the country's poorest citizens.

Navigating Climatescope

This Climatescope website is intended to be the most in-depth public resource for understanding clean energy conditions in emerging nations. Users are invited to:

- Watch a short video explaining high-level trends.
- Learn about all non-OECD clean energy finance flows.
- Understand developing nation climate policies in the context of the Paris Agreement.
- Discover the lessons learned for energy transition policies in emerging markets.
- Understand strategies to mitigate the risks of operating in developing countries.
- Assess clean energy policies in Climatescope nations at a high level then drill down through the policy library.
- See how individual countries scored in the Climatescope survey, then learn more about each by clicking on an interactive map, or compare nations.
- Analyze country-level conditions for off-grid clean energy development through a new data hub.
- And explore more insights, tools and regular updates at www.Global-Climatescope.org

Figure 1: Climatescope 2017 results



Section 2. Clean Energy and the Paris Promises

76%

of Climatescope nations have set emissions control goals

54%

have targets predicated on receiving financial help from wealthier countries

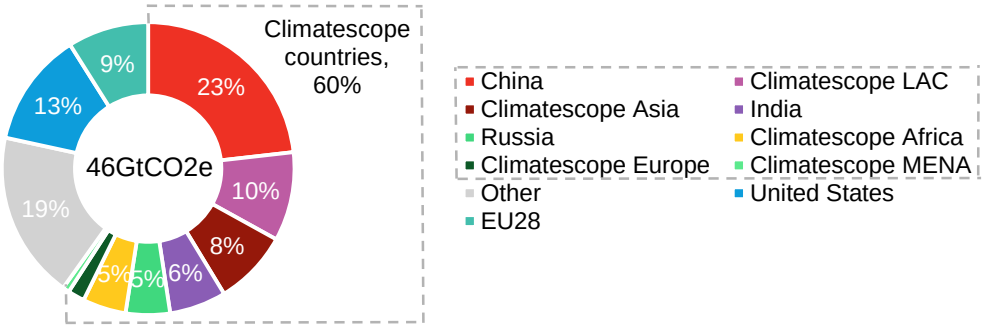
18%

have domestic laws to address emissions

The 2015 Paris Agreement saw virtually every nation on earth pledge to address the threat of climate change. Each country's Nationally Determined Commitment was unique, determined largely by economic and political circumstances. But nearly all presented opportunities for clean energy as zero-carbon technologies must inevitably be deployed if countries want to keep their power sector emissions in check. As part of its annual Climatescope survey of 71 developing countries, Bloomberg New Energy Finance sought to examine the ambition level of these developing nation NDCs and the opportunities each commitment presents for clean energy deployment.

- Nearly every Climatescope country was a Paris signatory. Fourteen pledged to cut emissions in absolute terms, seven to reduce them in terms of intensity, and 33 to allow them to rise but at a slower pace than under a business-as-usual scenario. Seventeen made no emissions-specific promises at all.
- Ten countries offered single commitments they promised to meet unconditionally. 19 said their commitments were conditional on wealthier nations providing financial assistance. 25 offered both unconditional and conditional promises. But two years since Paris, just 13 nations surveyed have actually implemented any *domestic* laws to limit emissions.
- Power and heat account for the single largest share of overall CO2 emissions in Climatescope nations at 30% and most of that is related to power generation. Emissions from the sector rose 65% from 2003 to 2012 and thus it presents major opportunities for mitigation.
- Countries with relatively high power sector emissions and the most ambitious NDCs offer the greatest opportunity for renewables. Among Climatescope countries, these included Azerbaijan, Argentina, Belarus, Chile, Mexico and Moldova. They could collectively achieve their entire unconditional targets purely by deploying clean energy.
- Latin America and the Caribbean is the only Climatescope region which would achieve absolute expected emissions cuts if its collective conditional target is met. It is also the region where renewables stand to make the biggest potential impact toward countries meeting their NDC obligations.

Figure 2: Climatescope countries GHG emissions and the rest of the world, 2012



Source: International Energy Agency, Bloomberg New Energy Finance. Note: the full list of Climatescope countries is available in the appendices.

- Climatescope countries with relatively low power sector emissions and the most unambitious targets included Bangladesh, Trinidad & Tobago, Turkey, Ukraine and Vietnam. In these nations, over 10% of total emissions come from the power sector. But they have relatively unambitious emissions reduction targets. Such high power sector emissions present policy-makers opportunities to craft more aggressive emissions control goals.

2.1. Introduction

This section takes a step back to look at the policy efforts these countries have taken collectively as a group since the Paris negotiations in 2015. Under Paris, virtually all Climatescope countries agreed to control their future CO2 emissions in one manner or another.

Specifically, we look the how the Nationally Determined Contributions interface with each country's power sector. That, in turn, gives us the opportunity to consider the role clean energy can potentially play in allowing nations to achieve their NDC goals. At the end of the note, we offer a few examples of nations that have a particularly interesting potential to leverage clean energy to address their NDC ambitions.

A note on methodology: The research in this note draws primarily from data that serves as the inputs for Climatescope's Parameter IV, which assesses country-level efforts to address greenhouse gas emissions. For Climatescope 2017, BNEF has revamped the methodology for calculating each country's Parameter IV score. That methodology will be detailed upon the project's full release at the end of November at www.global-climatescope.org.

2.2. The Paris Promises

Among the most noteworthy achievements of the Paris Agreement was that it included virtually every developing country in the world. Between them, non-OECD nations accounted for 68% of total global CO2 emissions in 2012 (the last year for which complete data is available). China alone was responsible for a quarter of emissions and India 10%. The 71 nations surveyed for Climatescope (which included China and India, among others) serve as a useful proxy for all non-

OECD nations[1]; between them, they account for 60% of the total GHG emissions worldwide (Figure 2).

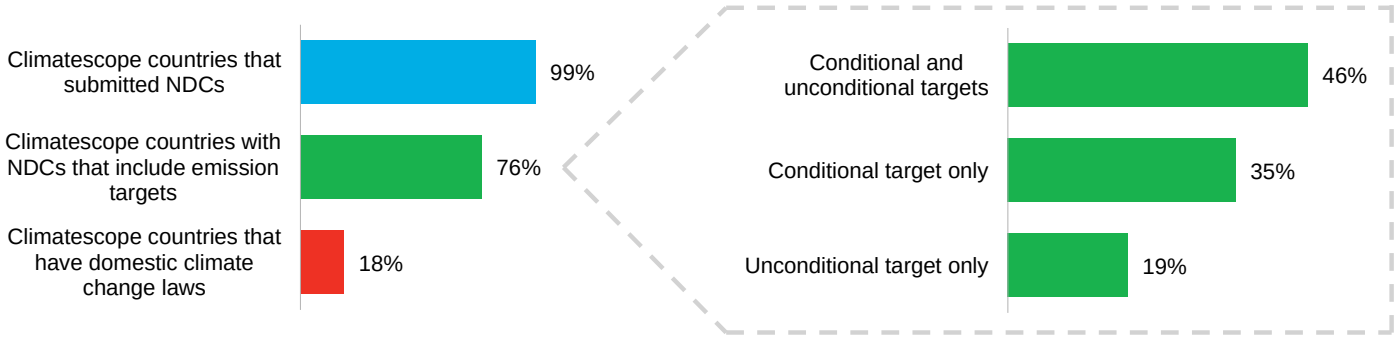
Moreover, less developed nations are where CO2 emissions are poised to grow fastest as they encompass some of the most dynamic economies in the world. BNEF estimates in its 2016 New Energy Outlook that power sector CO2 emissions from non-OECD countries will grow by nearly a quarter by 2040. By comparison, OECD countries are expected to see their power sector emissions drop by approximately half over that same time. There is no question that implementation of emission control policies must be a cornerstone of any serious global climate change mitigation effort.

Unfortunately, however, most countries that made promises under Paris have yet to follow through by implementing meaningful domestic policies to foster emissions reductions and, in turn, bolster clean energy growth. Of 71 countries surveyed by BNEF, nearly all have submitted Nationally Determined Contributions, but just 54 (76%) have included actual emissions reduction targets and only 18% have implemented domestic laws to address climate change (Figure 3).

Without such policies in place, investors are inevitably reluctant to deploy capital. The Copenhagen Accord, signed by the parties to the United Nation Framework Convention on Climate Change (UNFCCC) at COP15 in December 2009, saw developed countries promise to provide $100 billion in long-term financing annually to less developed countries to support the reduction of greenhouse gas emissions and promote adaptation to climate change. This commitment was reiterated in the 2015 Paris Agreement.

At Paris, 19 Climatescope countries presented "conditional" emissions control goals explicitly predicated on the condition that wealthier countries would follow through on the $100 billion promise. Another 25 of the 71 countries essentially submitted two pledges: one "unconditional" that they planned to follow through on regardless of the $100 billion and another, more aggressive, conditional goal to be achieved only if wealthier nations provided financing. The rest promised to follow through unconditionally – regardless of whether the $100 billion comes through (Figure 3).

Figure 3: Climate polices and emission reduction targets' conditionality



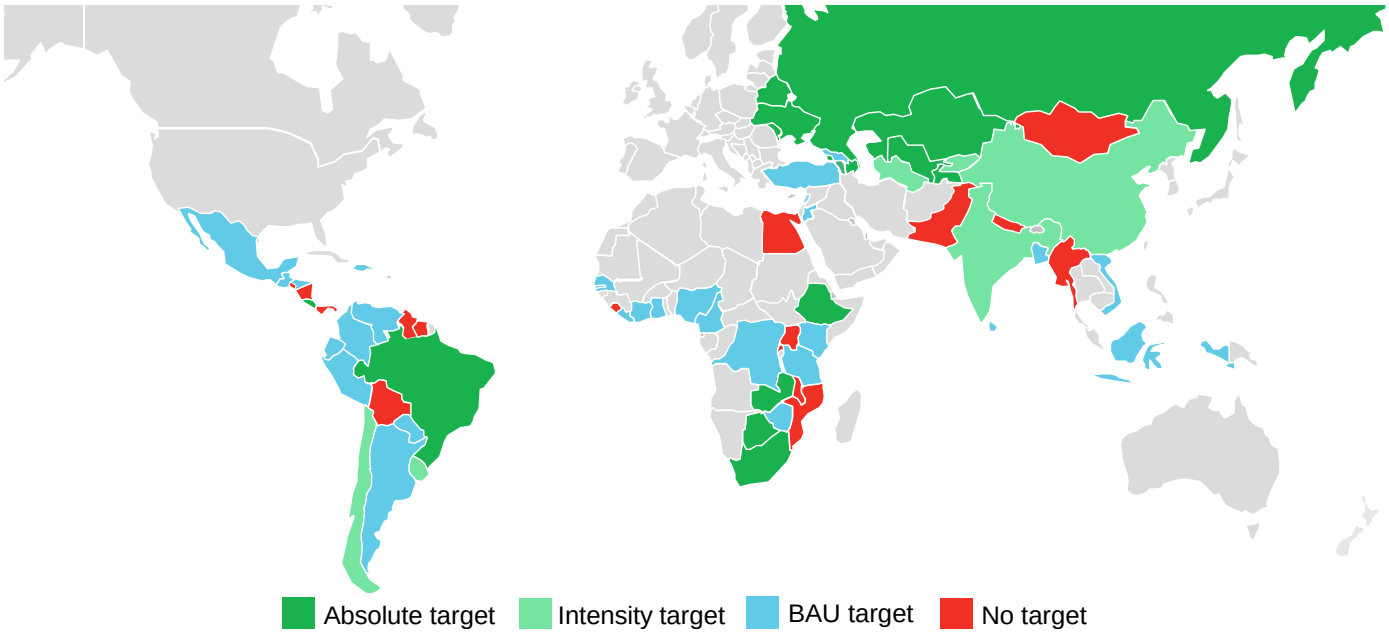
Source: UNFCCC, Bloomberg New Energy Finance

In terms of the pledges themselves, the 54 nations' emissions goals can be characterized as follows (Figure 4):

[1] Climatescope countries were responsible for 84% of all non-OECD emissions in 2012 and 86% of power/heat sector emissions from the non-OECD

- **Absolute targets.** Commitments made relative to total actual emissions in a base year and therefore a commitment to an absolute reduction. Fourteen Climatescope countries submitted absolute targets. Brazil, for example, has committed to reduce its GHG emissions by 37% from 2005 levels by 2025.
- **Intensity targets.** Commitments made relative to greenhouse emissions per unit of a country's GDP. Seven Climatescope countries submitted intensity targets. China, for example, has committed to reduce the level of GHG emissions per unit of GDP by 60-65% from 2005 levels by 2030. This would allow for a tripling of emissions from 2005 levels over the period if the economy grows by 5% a year.
- **Business-as-usual targets (BAU).** Commitments relative to a future BAU scenario, which takes into consideration future economic and population growth. A total of 33 Climatescope countries submitted BAU targets. Côte d'Ivoire, for example, has committed to reduce GHG emissions by 28% below its BAU trajectory by 2030. This would allow for around a 150% increase in emissions from current levels.

Figure 4: Climatescope countries with emissions reduction targets by type



Source: UNFCC, Bloomberg New Energy Finance. Note: includes the 71 Climatescope countries, which account for 84% of all non-OECD emissions and 60% of all emissions globally as of 2012. Countries listed as "no target" were signatories to the Paris Agreement but made no explicit commitment to rein in emissions.

Finally, with global emissions rising and the planet warming, there is the important question of how swiftly these nations have moved since the Paris conference two years ago to implement domestic policies to meet their NDC commitments. In that regard, clearly much work remains to be done. As noted, just 18% of Climatescope countries have climate laws on their books to cut emissions at home and only 28% have climate related incentives in force, such as carbon prices, carbon linked taxation or funding programs for emissions reduction. While 75% of countries have set national clean energy goals, relatively few of them have established binding mechanisms such as portfolio standards to ensure those goals are hit.

Still, there have been some bright notes in terms of domestic follow-through. Brazil, Costa Rica and Pakistan are all have taken steps at home to address climate change. Concurrent with the

Paris conference, Brazil enacted its National Climate Change Policy in December 2009 in line with its goal of cutting greenhouse gas emissions 36%-39% by 2020.

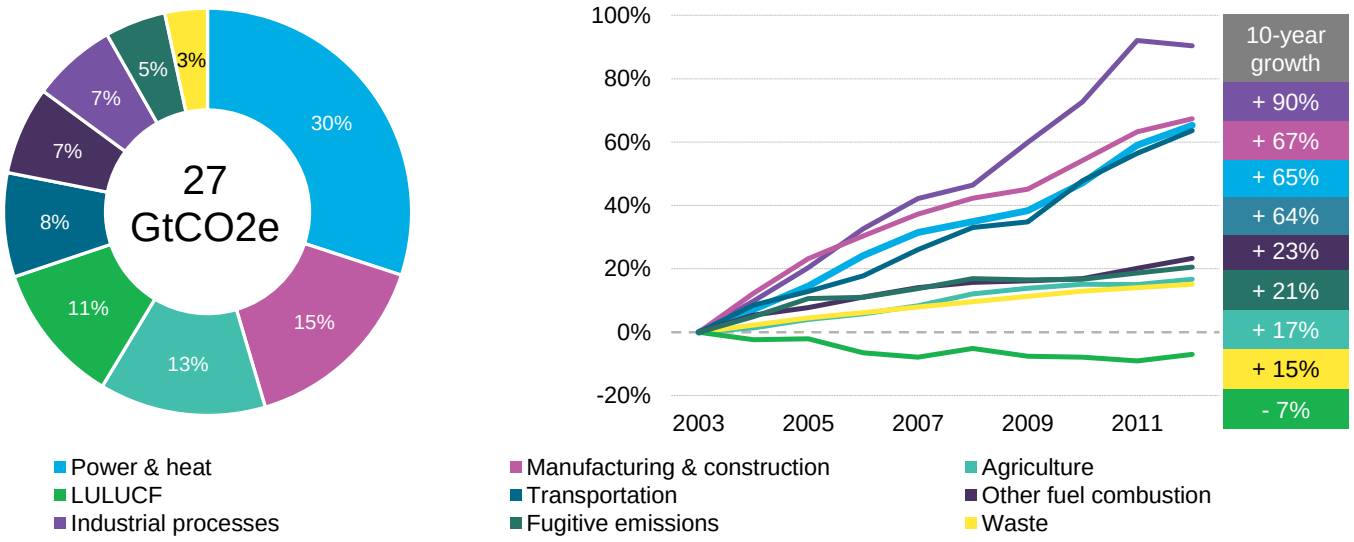
Costa Rica published its *Paz con la Naturaleza* program in July 2007, committing it to becoming an entirely carbon-neutral economy by 2021. Pakistan approved in March 2017 its Climate Change Act to meet its international obligations.

2.3. Clean energy and the NDCs

Power and heat account for the single largest share of overall CO2 emissions in Climatescope nations at 30% (Figure 5). The vast majority of this is related to power generation, largely because most of these nations have relatively mild climates and consume relatively little heat.

Power/heat is also among the sectors where emissions have risen fastest over the past decade, jumping 65% from 2003 to 2012 (Figure 4). Only emissions from industrial processes and manufacturing and construction have grown faster. Combined, however, these two categories still produce far few emissions than heat/power.[2]

Figure 5: Share of total emissions by sector in Climatescope countries, 2012 (left) and 10-year emissions growth rate by sector (right)

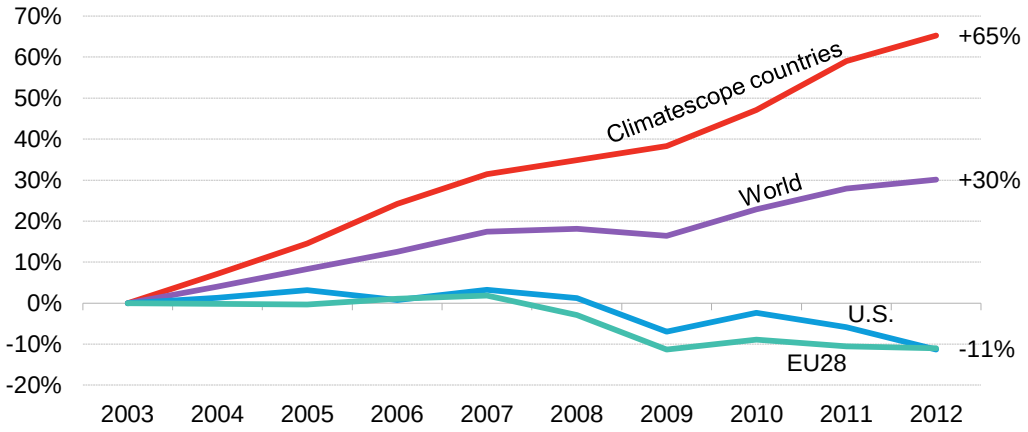


Source: International Energy Agency, Bloomberg New Energy Finance.

The rapid growth for power/heat is even more significant when compared to activity in developed markets. While over the past ten years power/heat emissions in Climatescope markets jumped twice as fast as the global average, in both the U.S. and European Union they dropped 11% during the same period (Figure 5).

[2] In nearly all the Climatescope countries, heat plays an insignificant role in total emissions compared to power, given the warm climate where the vast majority of these nations are located. Thus for the sake of our analysis, we use the IEA's estimate for power/heat interchangeably when discussing power sector emissions from Climatescope countries.

Figure 6: Ten-year power and heat emissions growth rate by country group



Source: International Energy Agency, Climatescope 2017

This trend is poised to continue as emerging market countries see their populations grow, economies expand and electricity access rates rise. That said, the threat posed by rising power sector emissions also presents potential opportunity. The power sector has to date proven to be the segment of the economy where the most developed countries have demonstrated they can make significant improvements on emissions. There is no reason lesser developed cannot do the same. With renewables costs dropping, there would seem to be little impeding such countries from turning to clean energy as their primary source for *new* generation.

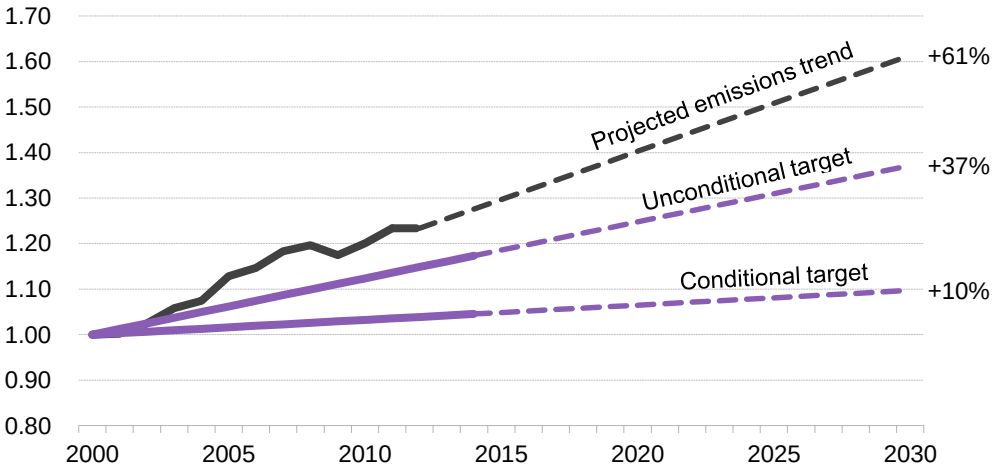
NDC ambitions

Given the many varieties of the pledges submitted as part of Paris, assessing the ambition of any one nation's emissions control goals is unfortunately a somewhat subjective exercise. However, it is worth undertaking when considering what tools countries might use to achieve their overall goals.

To start, we have compared each country's projected emissions trajectory should it follow recent trends[3] with its stated targets in absolute amounts. The wider the gap between projected growth and target growth, the more ambitious the NDC goal. For instance, Mexico committed to unconditionally to cut greenhouse gas (GHG) emissions by 25% below a BAU scenario by 2030 they themselves projected and to a further conditional emissions cut as deep as 40%, subject to international financial and technological support. In absolute amounts this will result in a 37% emissions rise from baseline year 2000 to target year 2030 for the unconditional target and a 10% rise under the conditional target (Figure 6). However, the country's projected actual emissions path suggests a 61% rise over the same period. Mexico's targets can thus be regarded as comparatively ambitious and will require some mitigation actions to come to fruition.

[3] Emissions trend was calculated based on emissions from 2000 to 2012

Figure 7: Projected Mexico emissions vs. its NDC target, rebased to the year 2000



Source: UNFCCC, Bloomberg New Energy Finance. Note: emissions rebased to 1 for illustrative purposes. BNEF forecasts future emissions based on the average emissions growth rate seen from 2000 to 2012, the last year for which complete data exists.

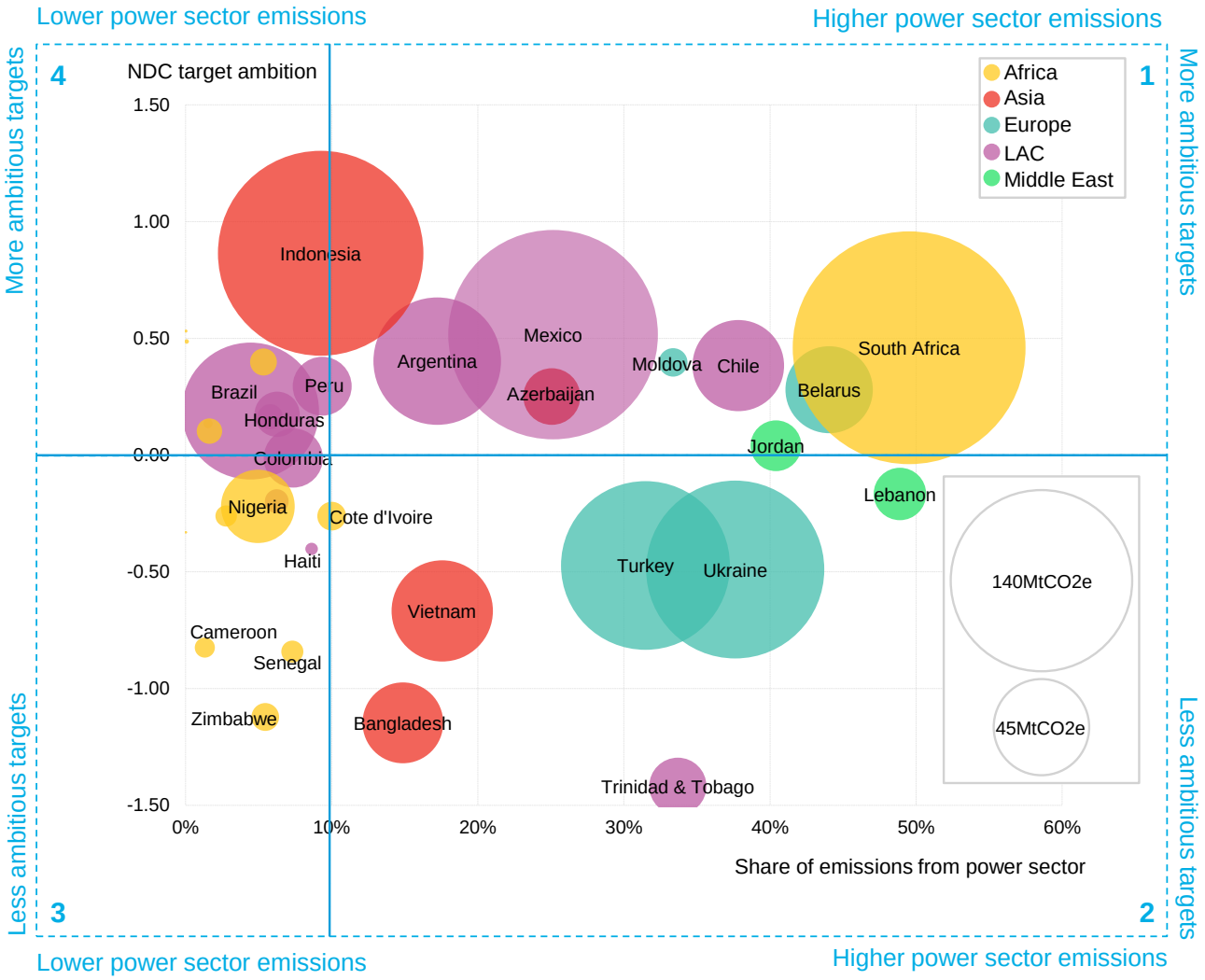
Ambitions vs. opportunities

We then sought to consider which countries may have the greatest potential to leverage clean energy to meet their CO2 goals. To do this, we examined the share each country's power sector-related CO2 emissions account for compared to its total emissions. We then compared this to the relative ambition levels of each country's overall CO2 control plans we previously calculated.

The countries illustrated in Figure 7 can essentially be divided into one of four categories:

1. **Countries with relatively high power sector emissions and ambitious targets** (top right). These nations offer the greatest potential opportunity for renewables as outlined under the NDC. In each, power sector emissions account for more than 10% of overall emissions. Each has set ambitious targets of cutting emissions below BAU, which will require appropriate mitigation targets.
2. **Countries with relatively high power sector emissions but unambitious targets** (bottom right). These nations also have power sectors that account for more than 10% of overall emissions. However, potential for clean energy could be limited insofar as the national goal is concerned as the government has set a CO2 goal no better than its projected BAU.
3. **Countries with low power sector emissions and unambitious targets** (bottom left). The power sector in these nations accounts for relatively limited emissions currently. These are also among the poorest nations surveyed under Climatescope meaning that as they grow their power sector emissions should rise. However, these nations also have unambitious CO2 control targets, suggesting that such growth could well be fueled by fossil generation.
4. **Countries with low power sector emissions but ambitious targets** (top left). The power sector in these nations account for a relatively small share of total emissions but the country has proposed to travel an emissions path below BAU. This suggests that such improvements could come from addressing emissions from land use, land-use change and forestry (LULUCF) sectors, rather than power.

Figure 8: NDC targets ambitions and share of emissions from power sector by country.



Source: International Energy Agency, UNFCCC, Climatescope. Note: Includes select Climatescope countries. When available, conditional target was used to calculate NDC target ambition. Bubble size refers to emissions from power/heat sector.

Countries that fall into quadrants three and four above present relatively limited opportunities for clean energy in terms of meeting overall country NDC goals. By contrast those in quadrants one and two offer real promise and are worth examining in greater detail.

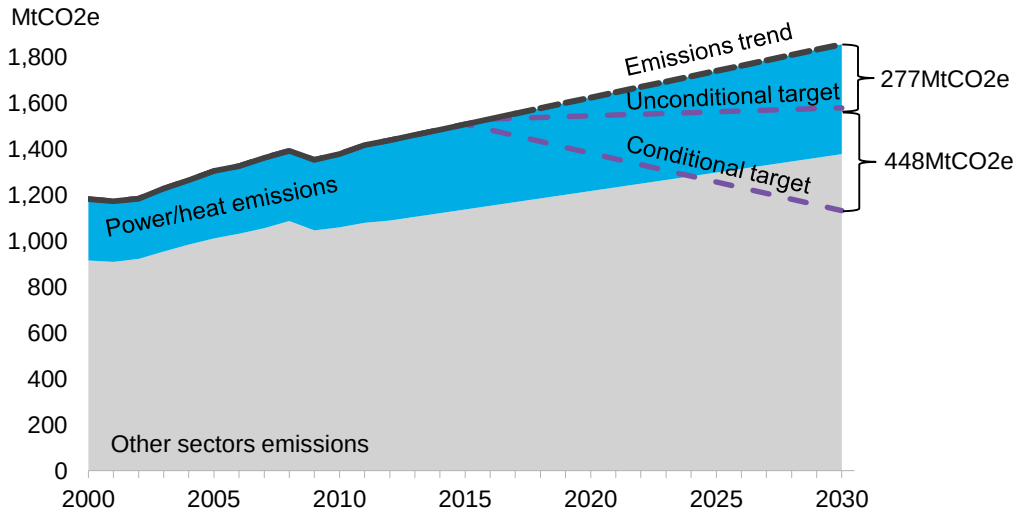
Higher power sector emissions and ambitious targets

Azerbaijan, Argentina, Belarus, Chile, Mexico and Moldova are among the Climatescope countries where NDC targets present the greatest opportunities for renewable energy[4]. Together,

[4] South Africa is not analyzed here because of its unique target. The country has pledged that emissions will peak, plateau and decline from 2025. This language sets the South African NDC apart from other major developing countries, as it not only specifies the timing of an emissions peak but also explicitly states that emissions will decline 'thereafter'.

these countries emitted a total of 1,438MtCO2e in 2012, 24% (350MtCO2e) of which came from the power/heat sector. Based on an emissions growth since 2000[5], this figure will grow respectively to 1,853MtCO2e and 478MtCOe by 2030. These countries must collectively limit emissions to 1,579MtCO2e to achieve their unconditional targets and 1,131MtCO2e to achieve their conditional targets. Compared to the emissions trend, this implies reductions of 15% (277MtCO2e) and 39% (725MtCO2e), respectively (Figure 8).

Figure 9: Emissions trends for Climatescope countries with relatively high power sector emissions and comparably ambitious targets



Source: International Energy Agency, UNFCCC, Climatescope. Note: Includes Azerbaijan, Argentina, Belarus, Chile, Mexico and Moldova. Note: Trend has been derived using historical emissions from 2000 to 2012. Targets were rebased to International Energy Agency's figures for consistency purpose.

In effect, these nations could collectively achieve their unconditional targets by mitigating emissions from their electricity sectors alone. In terms of domestic policy-making, that means that measures intended to favor new clean energy development over fossil build, or to accelerate retirement of fossil assets could see them through to meeting their goals. Based on current share of thermal generation technologies, we estimate this could be done by avoiding 53MtCO2e from coal generation, 175MtCO2e from gas and 49MtCO2e from oil. This represents around 482TWh that would need to be replaced by zero-carbon generation.

We have considered three scenarios (Table 1) under which that 482TWh in future demand would be met by different shares of solar and wind generation. In Scenario 1, the displaced fossil generation would be replaced equally by solar and wind generation. These countries would thus need to build a total 148GW of new solar capacity and 82GW of wind (for more details on specific country scenarios, see Section 2.4).

Using BNEF's current global benchmark capex for wind and solar, we estimate that this would require a total of $314 billion. However, BNEF estimates that PV costs will drop around 40%[6] and

[5] Estimate based on emissions trend calculated using historical emissions from 2000-2012.

[6] Bloomberg New Energy Finance's New Energy Outlook 2017: Solar

wind capex could drop by approximately 9% from 2017 to 2030[7]. Therefore this could dramatically shrink to $234 billion by 2030.

Table 1: Potential power sector emissions mitigation scenarios in Climatescope countries with relatively high power sector emissions and comparably ambitious targets

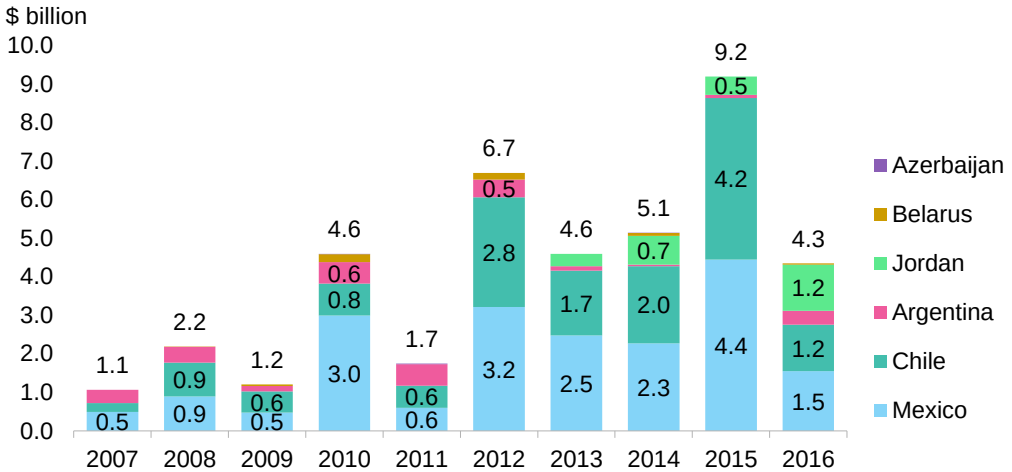
Emissions to be replaced (MtCO2e)	Scenario	Fossil fuel technology to be replaced		Equivalent new renewable energy capacity and generation		
		Share of emissions by source	Fossil fuel generation to displace		Technology share	Investment required ($ 2016)
277	**1**	63% / 19% / 18%	484TWh	Generation (TWh)	242 / 242	$314 billion
				Capacity (GW)	148 / 82	
277	**2**	63% / 19% / 18%	484TWh	Generation (TWh)	338 / 145	$322 billion
				Capacity (GW)	208 / 49	
277	**3**	63% / 19% / 18%	484TWh	Generation (TWh)	145 / 338	$306 billion
				Capacity (GW)	89 / 115	

KEY: Coal | Oil & diesel | Gas | Solar | Wind

Source: International Energy Agency, IRENA, Bloomberg New Energy Finance. Note: includes Belarus, Jordan, Chile, Moldova, Mexico, Azerbaijan and Argentina. Note: In order to arrive to the collective scenario, we have calculated each country separately, using BNEF's benchmark capacity factor and capex for each nation/region. Solar capacity factors range from 16% to 24% and wind capacity factors range from 25% to 47%, depending on the country.

Whatever the exact figure, a far smaller total of $41 billion was invested in clean energy in these countries from 2007 to 2016. Mexico and Chile were the leaders among these nations, recording $19 billion and $15 billion apiece, respectively. The higher level of investment is in no small part due to clear, effective policy frameworks in these countries. Argentina, Jordan, Belarus and Azerbaijan together have received only $6 billion to date.

Figure 10: New build renewable energy investment



[7] Bloomberg New Energy Finance's New Energy Outlook 2017: Wind

Source: Bloomberg New Energy Finance. Note: includes wind, solar, hydro up to 50MW, Geothermal, biomass and waste and biofuels.

Thanks to an energy reform and recent introduction of power auctions, new build renewable energy investment in Mexico jumped nearly four-fold from 2016 to 3Q 2017. In Argentina, despite little activity in prior years, investment is rising due to recent market reforms and the establishment of policy frameworks. As of 3Q 2017, the country had attracted $1.7 billion for renewable energy plants this calendar year. That matches the total raised over the prior *six years*.

Higher power sector emissions and unambitious targets

Bangladesh, Trinidad & Tobago, Turkey, Ukraine and Vietnam are Climatescope countries where over 10% of total emissions come from the power sector. But these nations have relatively unambitious emissions reduction targets. Such high power sector emissions actually present policy-makers opportunities to craft more aggressive emissions control goals.

To justify their relatively unambitious pledges on CO2 emissions, these nations have for themselves projected relatively steep rates of emissions growth under what they call BAU scenarios. These BAU lines are set so high they are easy for these countries to limbo under with the actual pledges they have made to control emissions.

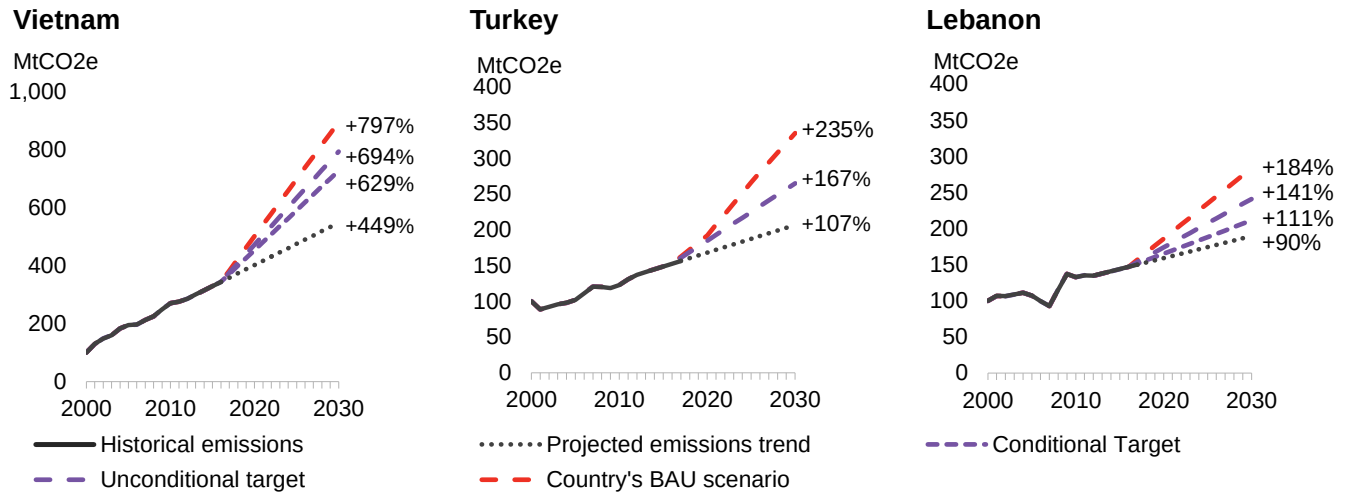
Vietnam's BAU scenario, for example, assumes that emissions will grow nearly 800% by 2030 compared to 2000 levels. The country's unconditional target aims to limit this growth to 694% and its conditional target to 629% (Figure 10). Turkey and Lebanon predict less dramatic jumps, but still expect emissions to grow respectively 235% and 184% over the same period. This is far from our estimated trend[8], which suggests 449% emissions growth in Vietnam from 2000 to 2030, 107% in Turkey and 90% in Lebanon.

These comparably unambitious targets and seemingly unreasonable BAU scenarios mean that these countries barely need to take any future action to meet their NDC goals. In fact, they can do even less than they would under any reasonable BAU scenario.

Vietnam, for instance, appears to be taking this to heart. From 2011 to 2016, the country added 12GW of new coal capacity. The record year for additions (3.3GW) came in 2015 when it submitted its NDC ahead of the Paris negotiations. As of December 2016, coal accounted for a third of Vietnam's 43.6GW capacity. Strong production from large hydro plants have depressed the coal plants' capacity factors and helped somewhat on emissions. Still, in 2016 coal represented one third of all power produced – and most of it came from plants built since the turn of the decade that stand to generate for decades to come. The country did also add 11GW of new large and small hydro capacity over that period, it should be noted, but virtually no wind or solar capacity.

[8] Estimate based on 2000-2012 emissions.

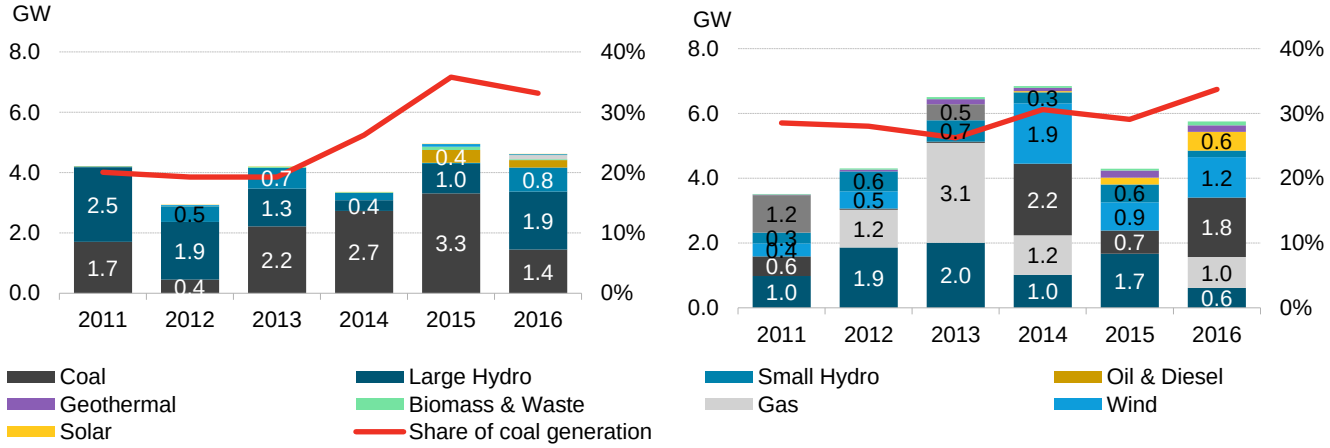
Figure 11: Emissions trends, targets and NDC BAU scenarios rebased to 100



Source: International Energy Agency, UNFCCC, Climatescope. Note: Turkey does not have conditional target.

By comparison, Turkey has made somewhat more progress in diversifying its energy matrix. From 2011 to 2016 the country added 5GW of wind and 832MW of solar while implementing a package of supportive renewable energy policies. However, this has not been enough to keep pace with rapid overall growth in power demand. As a result, the share of the country's generation from coal grew from 29% in 2015 to 34% (92TWh) in 2016 – its highest rate in six years.

Figure 12: Vietnam (left) and Turkey (right) capacity additions (left axis) and share of coal generation (right axis)



Source: EVN, Republic of Turkey Ministry of Energy and Natural Resources, Bloomberg New Energy Finance

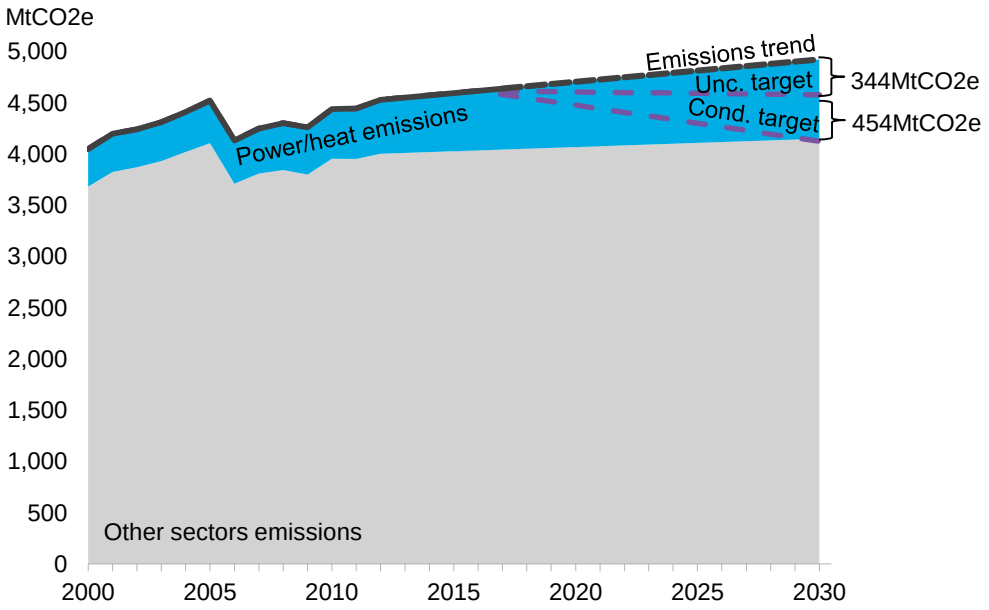
2.4. Case studies

Latin America and Caribbean

Under the submitted NDCs, Latin America and the Caribbean is the only Climatescope region which collectively would achieve absolute expected emissions cuts if its combined conditional target is met. It is also the region where renewables stand to make the biggest potential impact

toward countries meeting their NDC obligations. We estimate[9] that under a reasonable BAU scenario Latin America and Caribbean emissions will grow from 4,531MtCO2e in 2012[10] to 4,924MtCO2e in 2030 with over 15% (731MtCO2e) of this growth expected to come from the power sector. In the scenario, the region will need to cut emissions 344MtCO2e by 2030 to reach its collective unconditional target and 798 MtCO2e to achieve its collective conditional target (Figure 13).

Figure 13: Emissions trend and targets in Latin America and Caribbean



Source: International Energy Agency, UNFCCC, Climatescope. Note: includes 26 Latin America and Caribbean countries. Trend has been derived using historical emissions from 2000 to 2012. Targets were rebased to International Energy Agency's figures for consistency purpose.

Most notably, this means Latin America and the Caribbean can collectively achieve its unconditional target by mitigating emissions from the electricity sector alone. Based on current share of thermal generation technologies, we estimate that these countries could achieve the goal by mitigating around 128MtCO2e from oil generation, 122MtCO2e from gas and 95MtCO2e from coal, which represent around 506TWh generation per year.

We have considered three scenarios under which that 506TWh in future demand would be met by different shares of solar and wind capacity. In Scenario 1, the displaced fossil generation would be met equally by solar and wind generation, and these countries would need to build a total of 138GW of solar plants and 85GW of wind. This is eight times the region's current wind capacity and 39 times the solar capacity as of December 2016.

9 Estimate based on emissions trend calculated using historical emissions from 2000-2012.

10 International Energy Agency. Latest data available.

Table 2: Power sector emissions mitigation scenarios in Latin America and the Caribbean

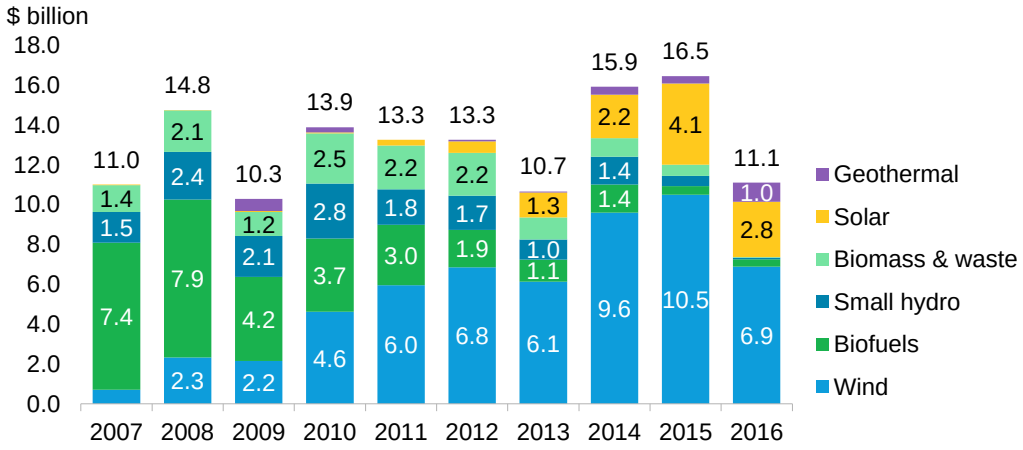
Emissions to be replaced (MtCO2e)	Scenario	Fossil fuel technology to be replaced: Share of emissions by source	Fossil fuel generation to displace	Equivalent new renewable energy capacity and generation: Technology share		Investment required ($ 2016)
344	1	27% / 35% / 37%	506TWh	Generation (TWh)	253 / 253	$348 billion
				Capacity (GW)	138 / 85	
344	2	27% / 35% / 37%	506TWh	Generation (TWh)	354 / 151	$365 billion
				Capacity (GW)	193 / 51	
344	3	27% / 35% / 37%	506TWh	Generation (TWh)	152 / 354	$331 billion
				Capacity (GW)	83 / 119	

KEY: Coal | Oil & diesel | Gas | Solar | Wind

Source: International Energy Agency, Bloomberg New Energy Finance. Note: includes 26 Latin America and Caribbean countries.

Using BNEF's latest benchmark capex for wind and solar, we estimate that this would require a total of $348 billion. However, BNEF estimates that PV costs will drop around 40%[11] and wind capex could potentially fall 9% from 2017 to 2030[12], therefore this could dramatically shrink to $256 billion by 2030. However, it is still two-fold the $130 billion invested in clean energy in Latin America and Caribbean from 2007 to 2016.

Figure 14: Latin America and Caribbean new build renewable energy investment



Source: Bloomberg New Energy Finance.

Chile

In September 2015, Chile submitted its NDC to the UN, committing unconditionally to cut greenhouse gas (GHG) emissions intensity per unit of GDP by 30% from 2007 levels by 2030.

[11] Bloomberg New Energy Finance's New Energy Outlook 2017: Solar

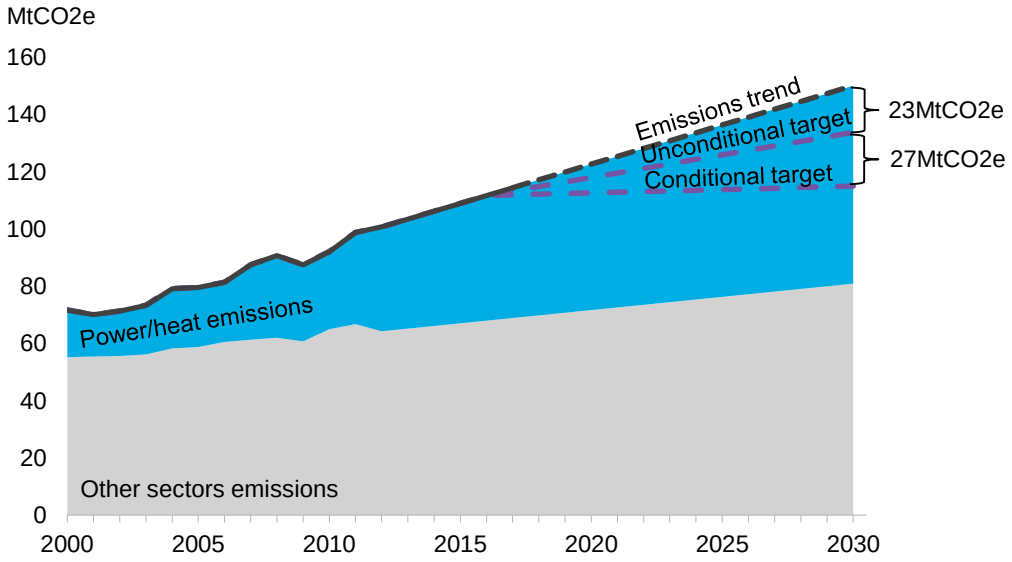
[12] Bloomberg New Energy Finance's New Energy Outlook 2017: Wind

The country committed to a further conditional reduction in GHG/emissions intensity. Specifically, it pledged to improve its GDP/emissions by 35-45% by 2030 if it received sufficient support from wealthier nations. In 2007 the country emitted a total of 124MtCO2e and we estimate[13] that would rise to 213MtCO2e by 2030.

Assuming a 3% annual increase in GDP, the country would need to limit emissions to 190MtCO2e to achieve its unconditional target and to 163MtCO2e to achieve its conditional target. This implies cutting 23MtCO2e to 50MtCO2e versus the emissions trend, respectively.

Like the Latin America and Caribbean region as a whole, Chile could potentially achieve its unconditional target entirely by mitigating emissions from its electricity sector. We estimate that the country can achieve this goal by avoiding 23MtCO2e from coal, the equivalent of 70% of the power generated from the source in 2016 (23TWh).

Figure 15: Chile's emissions trend and targets



Source: International Energy Agency, UNFCCC, Climatescope. Note: does not include emissions from LULUCF in accordance to Chile's target. Targets assume a 3% annual increase in GDP.

Our three scenarios where the 23TWh would be generated from different shares of solar and wind capacity are in Table 3. Under Scenario 1 where the displaced fossil generation would be equally replaced by solar and wind, Chile would need to build 5GW of solar plants and 3GW of wind. This is five times the country's solar capacity and three times the wind capacity as of December 2016.

[13] Estimate based on 2000-2012 emissions.

Table 3: Chile's power sector emissions mitigation scenarios – unconditional target

Emissions to be replaced (MtCO2e)	Scenario	Fossil fuel technology to be replaced		Equivalent new renewable energy capacity and generation		
		Share of emissions by source	Fossil fuel generation to displace	Technology share		Investment required ($ 2016)
23	**1**	100%	23TWh	Generation (TWh)	11.5 / 11.5	$13.4 billion
				Capacity (GW)	5 / 3	
23	**2**	100%	23TWh	Generation (TWh)	16 / 7	$13.8 billion
				Capacity (GW)	8 / 2	
23	**3**	100%	23TWh	Generation (TWh)	7 / 16	$13.1 billion
				Capacity (GW)	3 / 5	

Coal | Oil & diesel | Gas | Solar | Wind

Source: IIRENA, UNFCCC, Bloomberg New Energy Finance.

Assuming 2017 capex levels, we estimate that this would require a total of $13.4 billion. This is actually less than the total $15 billion invested in clean energy plants in Chile 2007-2016. And, as mentioned above, with PV wind costs declining this total may dramatically shrink to around $7 billion between by 2030.

Section 3. Policies for the energy transition: lessons learned in emerging markets

As the energy transition gains pace and strength, emerging market nations are leading the way, not just in terms of investment and deployment, but with innovative policy-making as well. Here we assess the clean energy landscape of the 71 countries studied for Climatescope by examining both the unique challenges they face and the novel policies they have crafted to overcome them.

$120 billion

2016 clean energy investment in Climatescope countries

60GW

Renewable energy capacity added in Climatescope countries in 2016

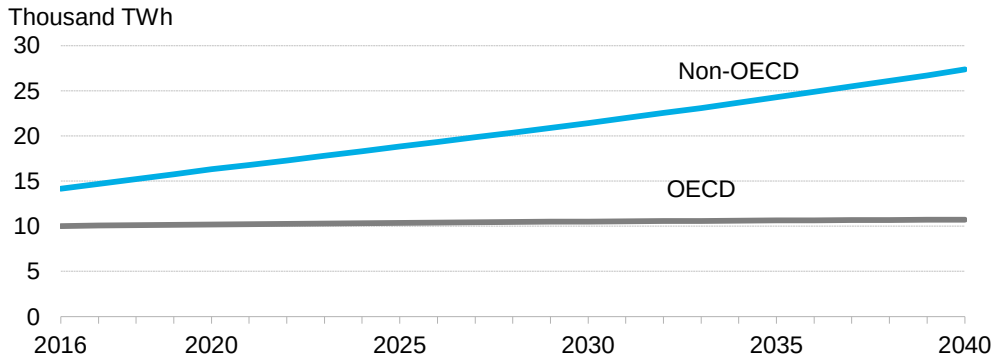
45%

Share of Climatescope countries with clean energy auctions in place.

- This year's Climatescope rankings reveal three general country groups:
  - *The Slow-Starters*, which have recorded little to no clean energy activity to date.
  - The *Capacity-Builders*, which are actively building policy frameworks that are showing results or could soon.
  - The *Ceiling-Hitters*, which have taken positive policy steps and attracted investment but have recently seen activity actually stall due to larger structural issues.
- Renewables targets in combination with auctions or feed-in tariff are the initial policy measures that have enabled the majority *Capacity-Builders* to move into this group and can be credited for most of the $709 billion invested across the 71 Climatescope countries between 2011 and 2016.
- The experience of the *Ceiling-Hitters* and some *Capacity-Builders* highlights the importance of taking a comprehensive approach to energy sector policy making to account for rapidly evolving demand patterns and the progress renewables have achieved. *Ceiling-Hitter* nations also often highlight the large investments required to expand grids and, in turn, ease renewable integration. At the other end of the spectrum, the right policies in markets with low electrification rates can avoid the need for large capital projects by instead supporting cost-effective distributed energy.
- In light of the dual challenges of improving energy access and addressing climate change, the fact that no less than 27 countries can still be considered *Slow-Starters* is alarming. National governments and development organizations are today spoiled for choices when it comes to policy lessons learned in developing nations.
- Country level examples of policy innovation include:
  - Mexico and its novel reverse tender system, which advantages developers who choose to build projects in under-supplied regions while disadvantaging those who go where supply is already abundant.
  - China and its plan to invest $270 billion to improve transmission and distribution through 2020, including 144GW of long-distance high-voltage lines. China is also slowly liberalizing its power markets so that buyers and sellers may someday negotiate not just on price but also, importantly, on the volume of electricity to be delivered.
  - Central America and its SIEPAC regional grid and accompanying Mercado Eléctrico Regional, which are enabling clean energy to flow freely across national borders to the region's seven nations.

– Peru and Rwanda, whose efforts to boost energy access include holding tenders in which off-grid developers/distributors compete for the right to provide electricity to millions, and other initiatives. Peru has already boosted its rural electrification rate from 29% in 2015 to over 78%.

Figure 16: non-OECD and OECD generation forecast



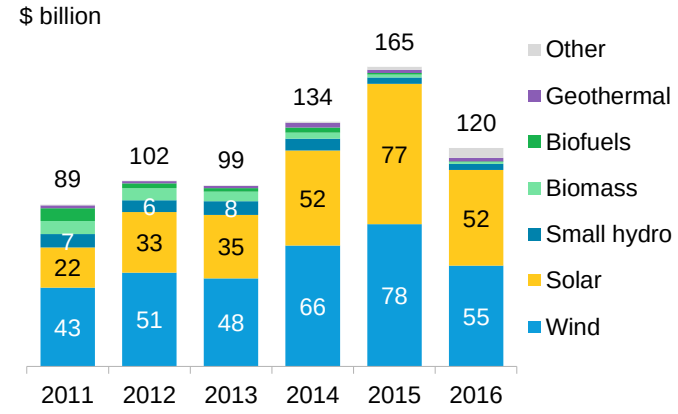
Source: Bloomberg New Energy Finance

3.1. Clean energy policy and deployment

Since 2010, developing countries have collectively accounted for a larger share of clean energy investment and deployment than wealthier countries. 2015 was a record year for both investment and installations with $165 billion (Figure 2) flowing to the sector and 67GW of generation capacity added to power systems across the 71 emerging markets reviewed in Climatescope (Figure 3). The sharp reduction in investment in 2016, the year following the Paris climate conference where over 200 nations came together and agreed to address climate change, is troubling. However, there is also evidence suggesting that 2017 and 2018 could see activity pick up again. Record investment in onshore wind in 2014 and 2015 is likely to translate into strong build in 2017 as there is a lag between when capital is deployed and projects are completed. Investment volumes in solar is where cost reduction impacts are most evident[14] and yearly installation levels continue to grow from record to record even when dollar volumes don't rise.

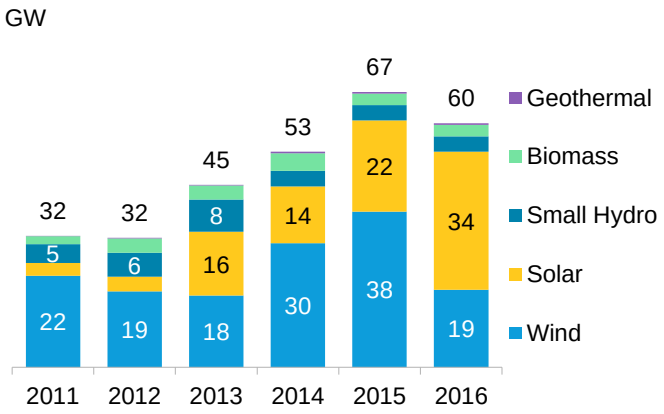
[14] BNEF estimates that for every doubling of cumulative installed solar PV module capacity the price reduces by 28%.

Figure 17: Annual clean energy investment in Climatescope countries



Source: Bloomberg New Energy Finance

Figure 18: Annual clean energy deployment in Climatescope countries

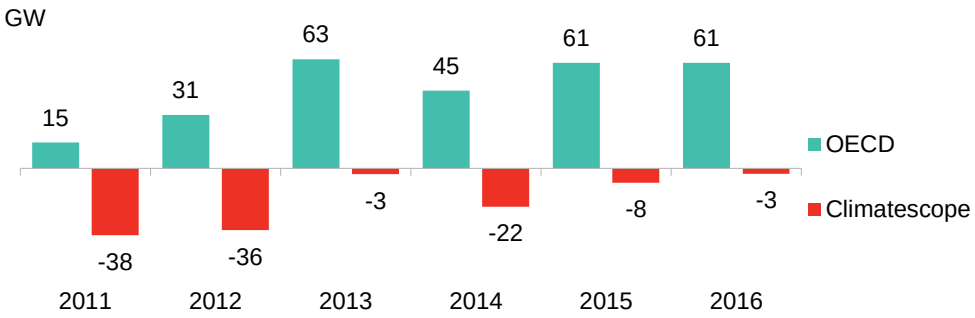


Source: Bloomberg New Energy Finance

Growing renewables deployment in emerging markets is all the more critical as they also lead in building the most new fossil fuel capacity to meet the demands of their growing economies (Figure 19). Unlike developing countries, the world's most developed countries are decarbonizing their energy systems at a much faster pace thanks to the combination of flat demand, fossil fuel power plant retirements and more affordable renewables.

The current scale of renewables activity was brought about by conducive policy environments in a group of front-running countries. China met the European Union's and its own early renewables deployment ambition by introducing generous feed-in tariffs and massively supporting growth of its renewables technology manufacturing capacity. Brazil ambitioned to fuel what was an economic boom from 2002-2011 at least in part with clean energy and introduced a program to hold auctions for clean power delivery contracts. Such tender systems are rapidly becoming the norm in top tier markets around the world.

Figure 19: Net carbon-neutral capacity additions by country group



Source: Bloomberg New Energy Finance. Note: Chart depicts total new build of fossil generation (coal, gas, and oil) minus total new-build carbon-neutral capacity (wind, solar, geothermal, hydropower, other renewables and nuclear) for each set of nations.

Yet, the 2016 investment figures indicate that a number of the busiest renewables markets of recent years are hitting what appear to be ceilings as the infrastructure and regulation needed to integrate all this capacity is being deployed. The data also highlight that clean energy investment is concentrated in a relatively small group of nations with the number of emerging markets

recording in excess of $100 million in investment in any one year stagnating at around 27 since 2010.

This note focuses on the policies that have enabled countries to jump-start clean energy activity, and on innovative measures introduced by those that have hit infrastructure and/or regulatory ceilings limiting further renewables deployment.

Initial power sector policies for clean energy deployment

Evidence from the 71 countries reviewed for Climatescope is clear: countries where responsibility for generation, transmission and distribution rest with a single fully-integrated monopolistic company are generally not conducive to renewables investment (Table 4). In fact, countries with such structures often have difficulty attracting private capital in general.

Table 4: Renewables investment in Climatescope countries by power market concentration and unbundling group

		Avg. 5 year investment ($m) over GDP			Cumulative 5 year investment ($bn)			Number of countries out of 71		
		Concentration of generation market								
		High	Medium	Low	High	Medium	Low	High	Medium	Low
Unbundling	Monopoly	6.45	-	-	0.8	-	-	12	-	-
	Generation	11.12	19.69	36.54	40.6	12.6	424.2	17	10	5
	Full	0.93	27.41	14.28	0.8	4.4	137.0	9	4	14

Source: Bloomberg New Energy Finance

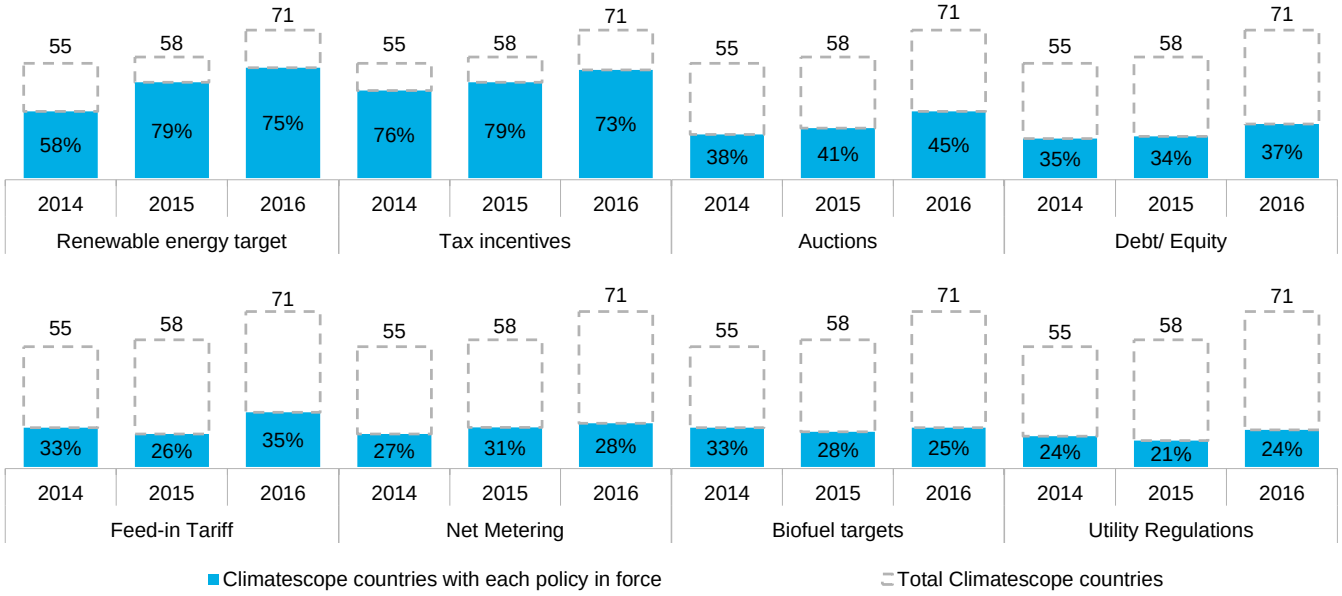
From 2012-2016, just $831 million in clean energy capital was deployed in countries with power systems monopolized by a single state-owned player[15]. That represents just 0.1% of all funds deployed during that period for renewables. There are certainly reasons why incumbent monopolistic utilities might resist liberalization and the associated proliferation of renewables. They need look no further than developed countries where major utility companies are being challenged by wind and solar, in particular. Conversely, for policy-makers, the most obvious rational for liberalizing generation is to foster competition, attract clean energy, and see prices drop for consumers.

Liberalizing the generation segment of the market need not preclude state-owned companies from participating in renewables development. Brazil and China are both examples where majority state-owned companies are co-existing with and competing against private project developers. Many majority state-owned utilities from developed and developing countries are now also using their size to invest internationally (see analysis on Investment).

Beyond market liberalization, renewables typically require additional support to gain a foothold in new markets, particularly where incumbent, fossil-produced power is being subsidized. Climatescope has been tracking the implementation of such policies in a growing list of developing countries (Figure 5), starting with Latin American nations in 2012. More countries were added in 2015 and this the list year expanded to 71 countries in Latin America, Middle East and North Africa, and Asia.

[15] Belarus, D.R. Congo, Liberia, Venezuela, Zimbabwe were the recipients.

Figure 20: Countries with clean energy policies implemented



Source: Bloomberg New Energy Finance. Note: Policies implemented indicates that the policy has been legislatively approved and all relevant regulations have been promulgated.

Targets are the starting point of most renewable energy policy frameworks. The number of countries that have introduced them has grown considerably from 2014 through 2016 as governments grow more aware of the opportunities lower-cost of renewables offer and the urgency of reducing power sector emissions. Three out of four Climatescope countries reviewed now have targets on their books.

Tax incentives are the second most popular renewables support mechanism in emerging markets and their popularity predates the recent way of renewables targets. This can partly be explained by the formerly high cost of renewables and the relatively low levels of deployment. Indeed, from a government's perspective, tax incentives are not terribly costly so long as build/investment levels and the associated tax collections are low. Tax incentives are thus a relatively blunt mechanism that when not combined with other incentives can see their costs rise as deployment levels grow. It is also worth noting that such incentives can typically be removed easiest as tax policies are often reviewed annually. India and member countries of the East African Community are examples of markets where tax holidays for renewables are being reviewed in response to growing activity in the sector.

Debt incentives, rather than often underfunded **equity incentives**, have proven to be extremely effective when they are well designed as they address the major challenge of access and cost of finance in emerging markets. Brazil's national development bank BNDES dominates clean energy lending thanks to the below-market rates and generous terms. The goal: incentivize development of a domestic onshore wind value chain. Lebanon's central bank's zero-rate lending program for PV projects is also a noteworthy success as it focuses on smaller scale projects.

Utility regulations include a wide group of policies. The ones known to drive clean energy deployment most are ambitious renewables portfolio standards and green certificate markets. However, their use is relatively limited in emerging markets to date. Of the 17 Climatescope countries that have utility regulations in place, most have introduced policies like priority grid access and guaranteed purchase rules in favor of renewables. These policies can play an

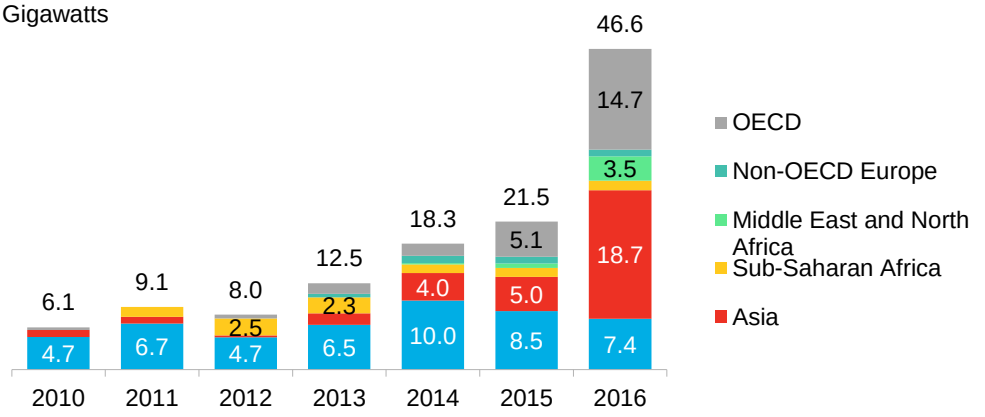
important role in helping renewables developers but cannot support growth in the sector on their own.

Feed-in tariffs (FiTs) and **auctions** are the policies that have supported the vast majority of renewables procurement globally to date. Emerging markets, Brazil and the rest of Latin America in particular, have pioneered the use of auctions that invite developers to bid to sell their power at least cost. Tenders for power contracts are by no means new in the context of emerging markets, however. What has been novel is the extension of these to renewables specifically. In contrast, the reputation of FiTs set by regulators has suffered in recent years in the wake of the European experience. In some EU countries, generously priced FiTs prompted unexpectedly large and sudden booms in renewable build. This, in turn, resulted in ballooning public subsidy liabilities and put considerable pressure on electricity bills or government budgets. However, FiTs can play an important role in supporting small-scale projects for which the costs of organizing auctions can be prohibitive.

Clean energy auctions: from Latin America to a global phenomenon

The popularity of clean energy auctions has grown globally to developing and developed nations alike, but the trend clearly began in emerging markets (Figure 21). Contracts auctioned globally more than doubled from 12.9GW in 2015 to 34.2GW in 2016, and the 2016 volume was already matched in the first six months of 2017.

Figure 21: Cumulative global auctioned capacity

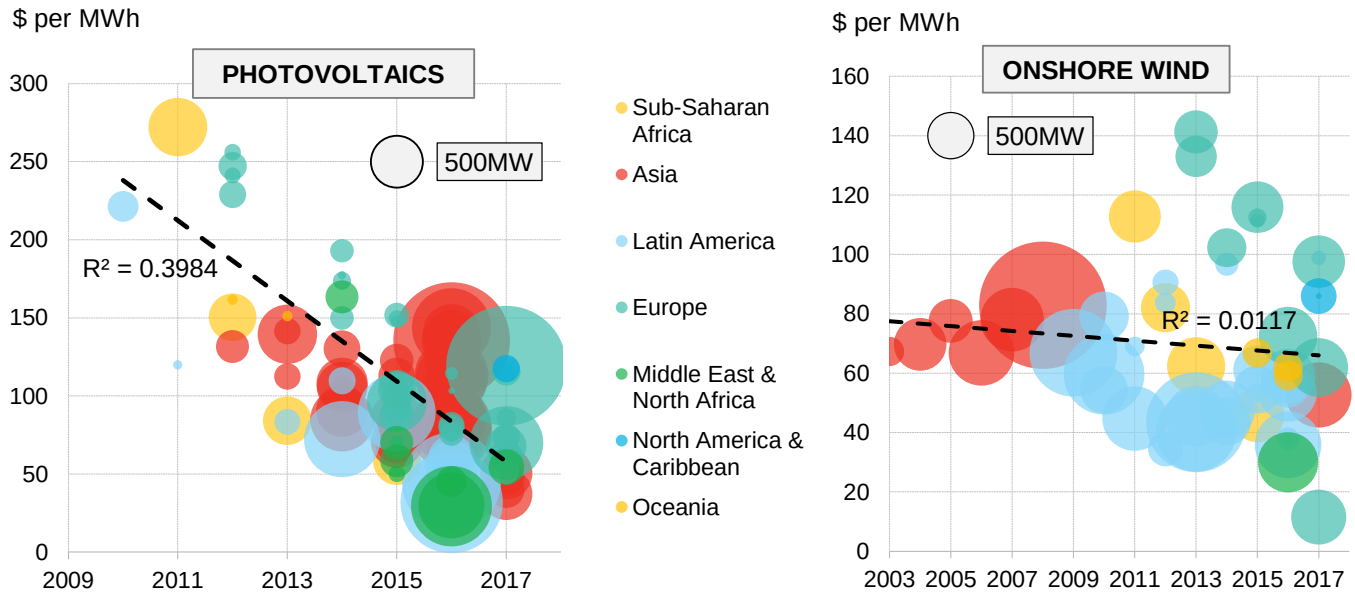


Source: Bloomberg New Energy Finance

Policy-makers and developers alike are generally attracted to well-organized auctions because, at their best, they offer transparency, foster competition, and produce affordably-priced power contracts. This has resulted in dramatic cost reductions across the vast majority of the markets where they have been introduced (Figure 22). Auctions for solar power delivery contracts in particular have allowed governments to reap benefits from continued cost declines from the trend toward commoditization of photovoltaic modules.

Progress for onshore wind sector has trended similarly to larger infrastructure projects as wind project costs are more linked to local operating conditions, which can often be difficult in emerging markets (see analysis on Risk). Nevertheless, it is important to note that clearing prices alone do not show the full extent of the progress made in the wind industry which has delivered remarkable improvements in capacity factors thanks to ever bigger turbines and better wind forecasting.

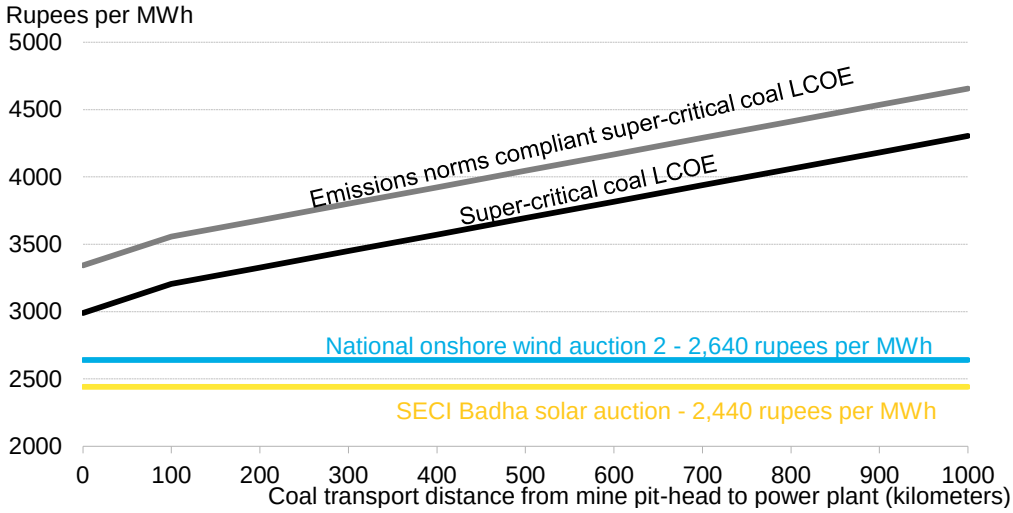
Figure 22: Global clean energy auction clearing prices and awarded contract volumes



Source: Bloomberg New Energy Finance

Record low auctions prices for solar and wind are turning the century-old cost relationship between fossil fuel and renewables upside down in a rapidly growing number of markets. India's adoption of auctions has given birth to the most competitive renewables market in the world.

Figure 23: Levelized cost of electricity of super-critical coal power generation by coal transport distance in India and select 2017 PV and onshore wind auction prices



Source: Bloomberg New Energy Finance. Note: Solar Energy Corporation of India (SECI)

Receiving bids to provide 10 times as much power as tendered was the norm in most solar auctions in India in 2016 where more than 4GW being auctioned. High competition has resulted in solar and wind project developers committing to deliver electricity at prices below the cost of coal generation by 2020 (Figure 23). These bids have major implications for India, the coal industry, and the world at large given India's current and future role in CO2 emissions. The Indian

government has already responded to these bids by reducing its coal-fired power generating ambitions in favor of renewables.

It should be noted that the intense competition and extreme low bids in India are raising questions about whether current market dynamics are sustainable. Auction bids are formulated and submitted years before development starts and developers appear to operate under the assumption that solar equipment prices can only fall in the future when there is at least the possibility of a price uptick, at least temporarily, at some point due to supply bottlenecks or other issues. Bids should start to rise as developers adapt to changing market conditions or react as projects that had previously won bids get cancelled.

Given the critical role solar is poised to play in helping India expand energy access, the government will need to watch closely for signs of irrational bidding as the country's auction program is growing at an unprecedented pace. This is particularly true as India's often undercapitalized banks are now more exposed than ever to renewables.

Away from India, there are many other examples of where clean energy is undercutting fossil fuel based generation. In Chile, renewables have for years won power supply contracts in technology-neutral auctions competing directly with fossil-fueled plants. The remarkable cost reductions delivered by the renewables supply chain and the pull effect of auctions have succeeded in solving the affordability challenge of clean energy deployment. This even holds true for markets that have recorded little clean energy sector activity to date as was shown with the recent bids recorded across the Middle East and earlier in South Africa.

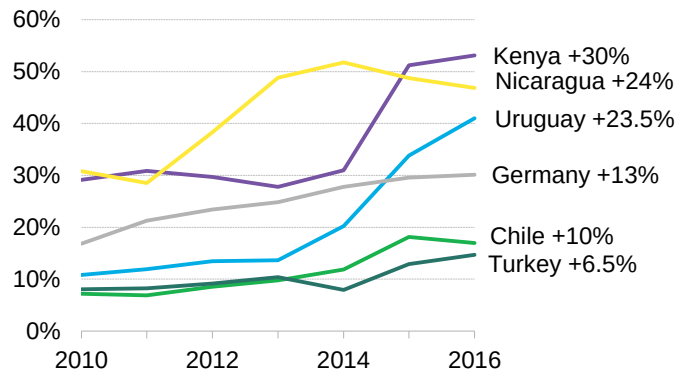
In light of the dual challenges of improving energy access and addressing climate change, the fact that such a large group of countries still is recording little to no investment is alarming. National governments and development organizations are today spoiled for choices when it comes to lessons learned. The rest of this analysis focuses on policies and regulations required to scale renewables while addressing challenges that can accompany them.

3.2. Cracking the renewables deployment ceiling

Most of the 16 nations that scored 1.75 (out of 5) or higher in this year's survey have taken key policy steps to attract investment and deploy large volumes of renewables successfully. These countries have recorded clean energy investment and deployment activity at least equivalent and sometimes larger than those seen in Germany, the self-proclaimed energy transition global leader, or the U.S. (Figure 24 and Figure 25).

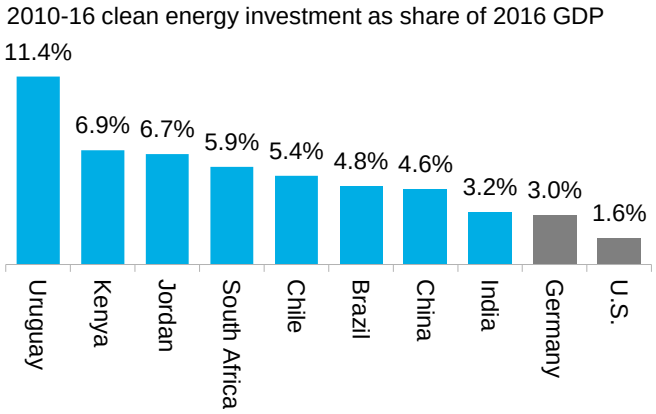
One of the main challenges to increasing renewables at this pace is their technical and financial integration with the energy system and the economy at large. Indeed, renewables deployment targets to date have seldom been designed with overall electricity supply and demand dynamics in mind. Sometimes decisions are taken in two or more different ministries which both want the best for the portfolio of sectors they oversee.

Figure 24: Renewables as share of total generation



Source: Bloomberg New Energy Finance

Figure 25: Renewables investment relative to economy size



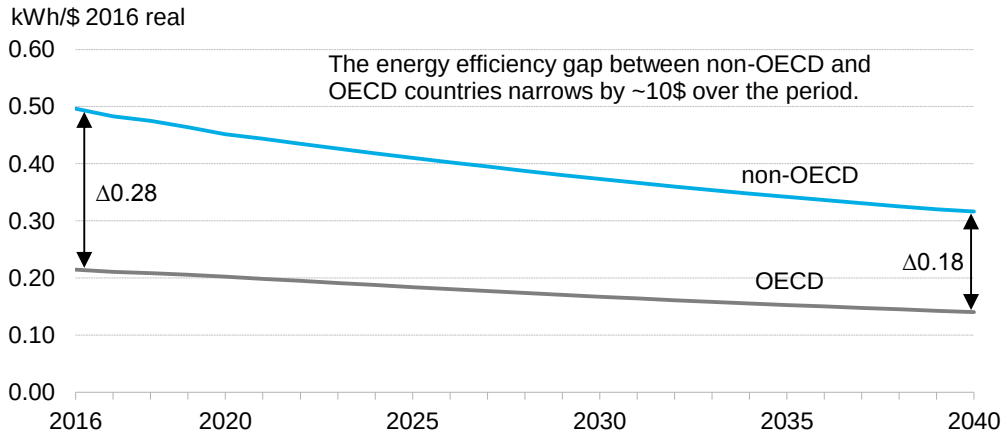
Source: Bloomberg New Energy Finance

A comprehensive approach to energy policy-making has always been critical. But the challenge of doing so now is arguably taller than ever as rapidly falling costs and evolving innovation create ever-changing circumstances with wide-ranging implications. There are also the challenges associated with conventional institutional thinking; some policy-makers still resist the idea that power-generation can be de-centralized, not necessarily available 24 hours a day, or fired by fossil fuels.

Electricity demand and renewables deployment

As they grow and mature, economies tend to become more energy efficient. For most developed countries, this is the result progressing away from energy-intensive industrial activity to more services-oriented activities. The energy efficiency of emerging market nations is expected to catch up with wealthier countries as they grow and shift toward services (Figure 26).

Figure 26: OECD vs. non-OECD projected electricity intensity: BNEF Outlook

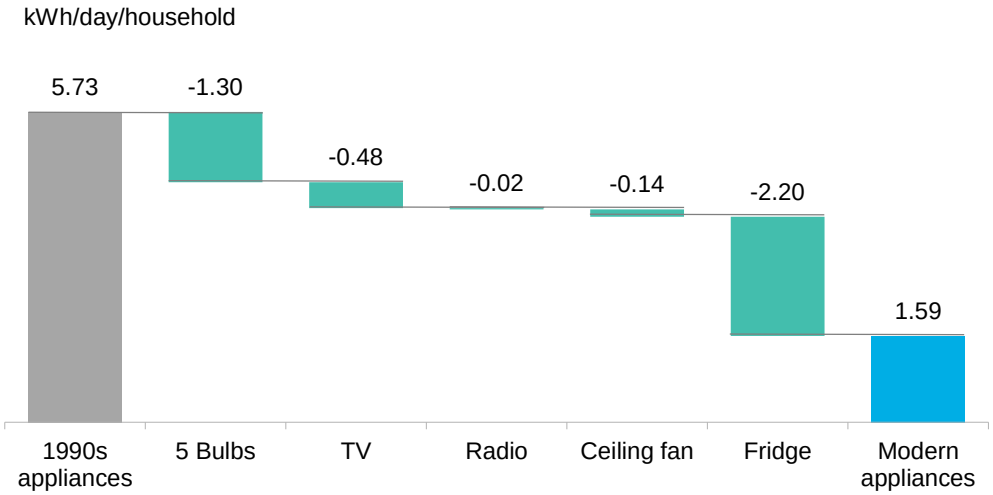


Source: Bloomberg New Energy Finance New Energy Outlook 2017

However, rapid development in technology and the increasing digitalization brought about by the Internet are challenging the theory of a steady transition from agriculture to industry and to services. Countries like India, Nigeria, Morocco or Kenya are all home to booming IT sectors while their industrial activity is seeing more modest growth. The electricity consumption of

electronics has gone through an efficiency revolution of its own since the 1990s. A typical set of home appliances consumes less than a third of the energy it did back then (Figure 27).

Figure 27: Home appliance energy consumption and efficiency improvements



Source: Bloomberg New Energy Finance, Energy Use Calculator, Shah 2014. Note: assumes 2.25 hours of TV consumption per day on a 30W LED TV vs 110W CRT and 22" ceiling fans running five hours per day on 32W vs 59W.

The aggregate impact of these improvements is huge. Two decades ago, meeting the basic power needs of the 1.2 billion people without access would require just under 500TWh per year – equivalent to the demand of a mid-sized G20 country such as South Korea. With modern appliances, the same service today would require just under 30% of what it did back then.

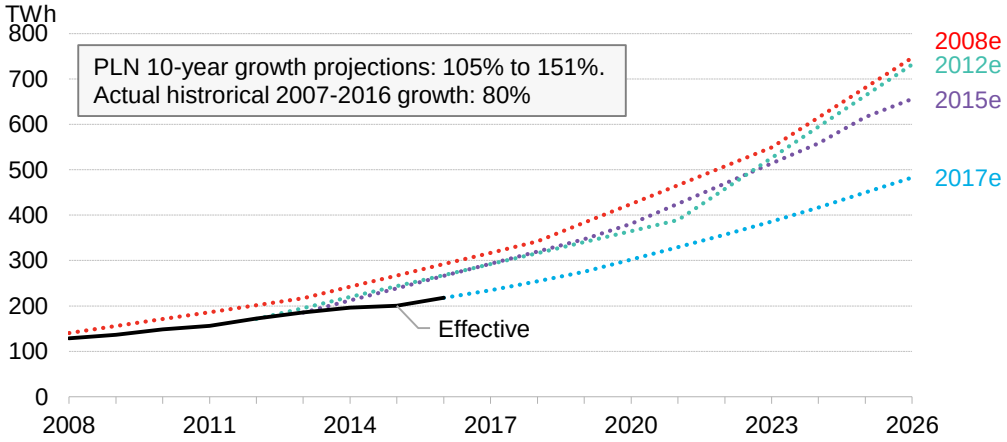
Regulator and utility forecasting woes

Changing consumption trends are creating major headaches in all segments of the energy world. But the challenges may be most acute in the power sector where regulators and utilities are tasked with guaranteeing energy supply at optimal cost while anticipating their economy's future electricity needs.

By default, regulators and utilities have tended to be overly bullish about future demand growth. In liberalized systems, this can lead to severe distress for investors as market gluts lower revenue until excess capacity is removed or demand recovers (such as in Brazil during the most recent recession).

Figure 28 shows the challenges Indonesia's state-owned utility Perusahaan Listrik Negar (PLN) has had forecasting demand in recent years. The growth rate it forecasts for the next decade is 30-90% higher than growth seen in the last decade. This is despite the fact that Indonesia has seen less expansion of energy-intensive manufacturing in recent years than in less intensive telecommunications. The utility's miscalculations have had severe consequences on the financial balances in the energy sector. PLN is heavily indebted and is considered at risk of default by the country's finance ministry despite receiving large, repeated capital injections. This in turn creates challenges for renewables development simply because funds are lacking and adding them to an already oversupplied system would further reduce the utilization of the existing generation fleet.

Figure 28: Indonesia effective electricity demand vs. Perusahaan Listrik Negara (PLN) projections



Source: PLN, Bloomberg New Energy Finance. Note:

India's search for load

One positive response to the challenge of over-supply is to add demand by expanding energy access to populations yet to be connected to the grid. Along those lines, India's government has paired its large-renewables procurement goal with a $14.2 billion electrification program which has the ambitious goal of electrifying all the villages in the country by the end of 2017, and to enter all homes by year-end 2018 (Figure 29 and Figure 30). The plan is expected to provide an additional 80TWh of electricity and boost demand 7% from 2016 levels.

Figure 29: India village electrification vs. target

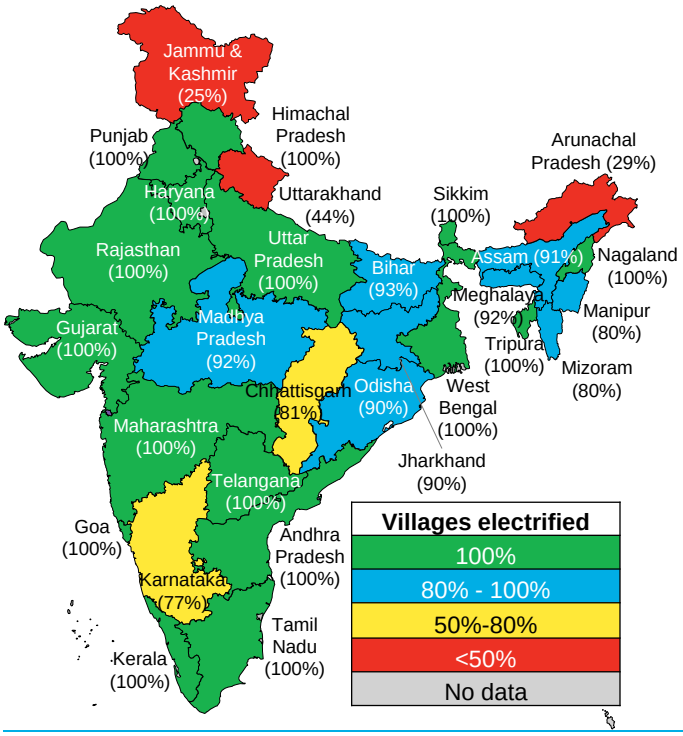
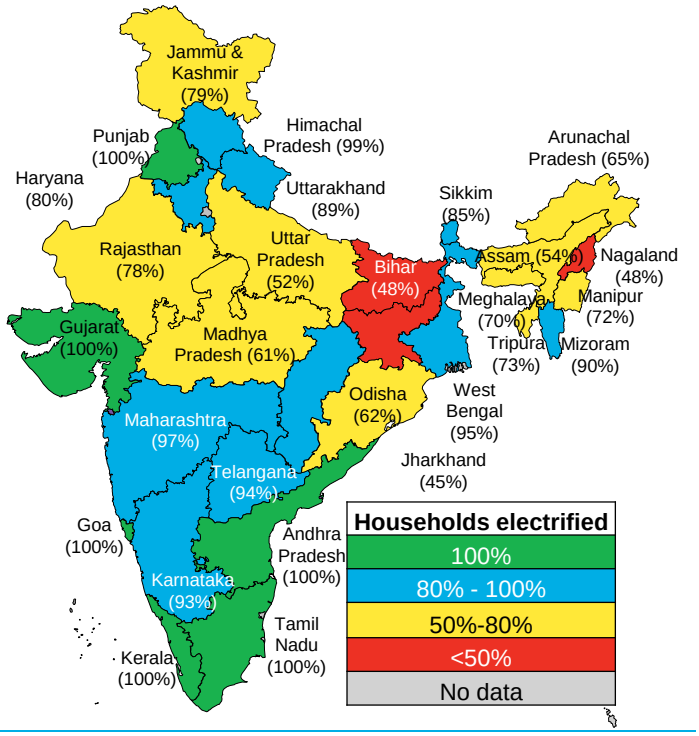


Figure 30: India household electrification vs. target



Source: Bloomberg New Energy Finance, Rural Electrification Corporation. Note: the achievement (in %) is against the target of villages for the respective state which was un-electrified on April 1, 2015. The number of villages electrified is as per the data reported by the Rural Electrification Corporation in November 2017.

Source: Bloomberg New Energy Finance, Rural Electrification Corporation. Note: The number of households is as per the data reported by the Rural Electrification Corporation in November 2017 and represents only rural households.

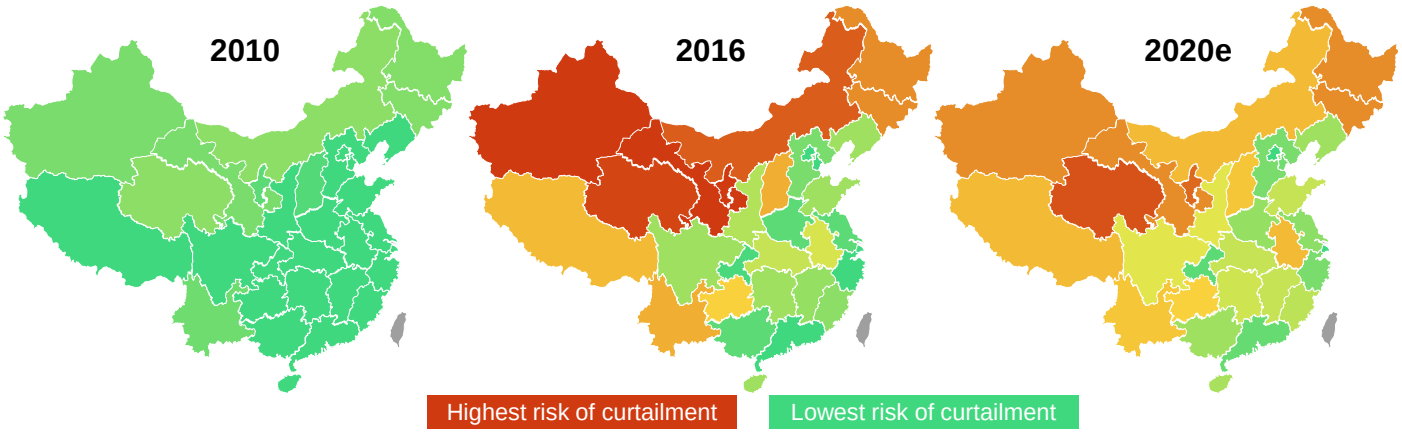
Distances between demand centers and where renewable power generation makes most sense add a further layer of complexity. Locations with the best solar radiation or strongest winds are best can be inhospitable even uninhabitable. This forces policy-makers to come up with novel solutions.

China's East-West demand and supply mismatch

Much of China's installed 244GW of solar and wind has been deployed in the country's northwestern area where natural resources are best. However, this is also furthest from the country's very largest demand centers to the east. Developers went northwest in search of highest yields on a FiT scheme that applied uniformly across the country, much the way Germany developers built projects in the windiest north of that country, away from consumption centers.

Record deployment in China has led to rising curtailment rates and losses of revenues for generators in the most affected regions (Figure 31). At 17% for onshore wind in 2016, and 10% for solar, China's renewables curtailment levels are the worst in the world. The size of the government's response is in line with the ambition of adding over 100GW of generating capacity to the system every year. Between 2016 and 2020, China aims to invest $270 billion in its transmission and distribution networks (3% of 2016 GDP). The budget includes investment in 144GW of long-distance high-voltage transmission lines, by far the largest deployment of such infrastructure in the world to date. In July 2016, the Chinese government also introduced an "onshore wind investment risk alert" which effectively put a hold on new build in the western provinces with high curtailment. A similar mechanism was introduced for solar in the summer of 2017. As a result, BNEF expects western curtailment risk to fall by 2020.

Figure 31: China generation curtailment risk



Source: Bloomberg New Energy Finance and Climateworks "Mapping China Renewables Curtailment and Coal Risks" (link)

Governments with lofty renewables goals today can look to China as an example of why policy supports should often have some degree of geographic specificity. But the country is also in the process of demonstrating how geographic biases can get resolved longer term.

Mexico's comprehensive solution to renewables deployment

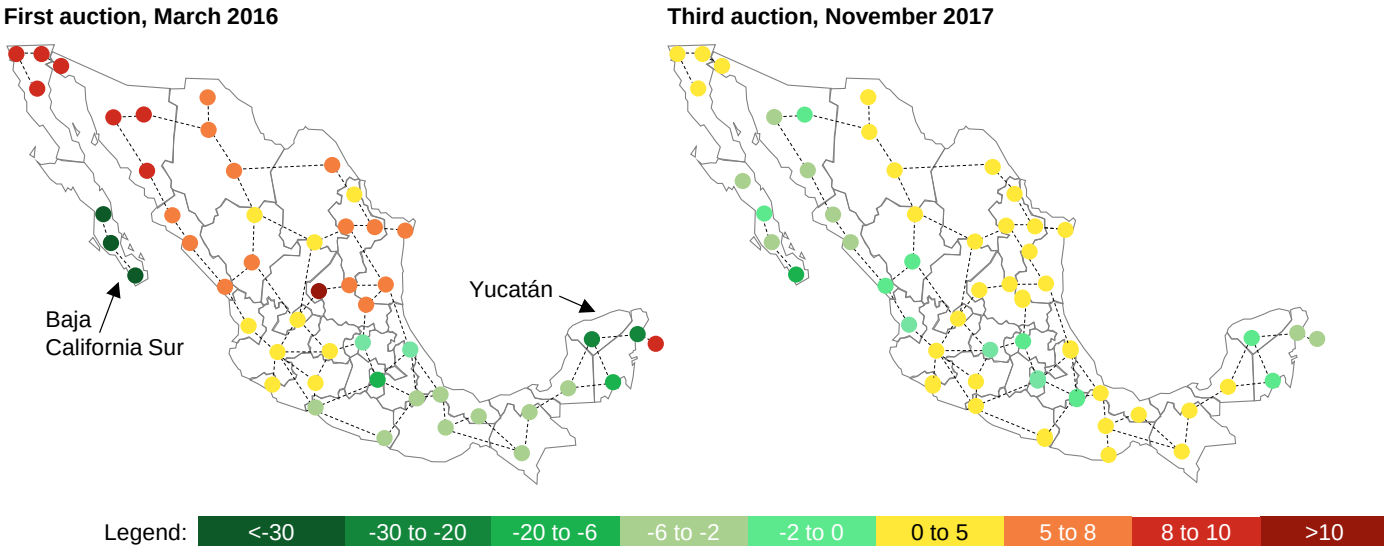
For its part, Mexico has explicitly sought to differentiate government support provided to clean energy projects in different parts of the country based on need. Launched in 2013, the country's major energy sector reform exemplifies not just how risks of overbuild in specific regions can be mitigated, but how policies can be structured to fully leverage resources.

Specifically, Mexico has a unique system for tendering clean power-delivery contracts. This mechanism includes an explicit nodal price adjustment provided to incentivize developers to locate projects near nodes where generation is less readily available. The system also essentially discourages new projects where supply exceeds demand.

After being received by the regulator, each bid is adjusted for the purposes of determining the potential winner by the nodal factor, but the adjustment does not affect the actual price in the PPA signed by winning developers. For example, a project located in an area with sufficient generation that has a nodal difference of $5/MWh and bids $40/MWh will compete against other bids as if its offer was $45/MWh. On the other hand, a project located in a region with a supply shortage will see $5/MWh discounted from $40/MWh and valued as if it were $35/MWh in the auction-clearing process. This second project will win a $40/MWh PPA.

The first three auctions held in Mexico have succeeded in addressing many of the supply imbalances reported by the regulator (Figure 32). In the first auction, nodal differences ranged from +$10.7 to -$34.3. This $45 gap between highest and the lowest nodes decisively affected the winning projects list. Half of the contracts awarded in this first auction went to projects located in the two states with the highest nodal discounts: Yucatán and Baja California Sur. The third auction held a year later saw the range between nodes reduced to $13.5 as a result of the success of the previous rounds.

Figure 32: Mexico's first (left) and third (right) auction's nodal price adjustments



Source: CENACE, Bloomberg New Energy Finance.

In addition to incentivizing renewables build where it's needed most, Mexico's energy policy seeks to facilitate clean energy integration through ambitious transmission network expansion and modernization. Among the goals: connecting Baja California's isolated grid to the central system and increasing interconnection with the U.S [16]. The plan targets installation of 19 new transmission lines for over 31GW of capacity to take total transmission capacity to 74GW. Here too, Mexico is planning to fully leverage competition by awarding build and transfer contracts for the development of the new lines in five auctions. The full set of measures aims to attract $21 billion of investment into transmission and distribution networks by 2031.

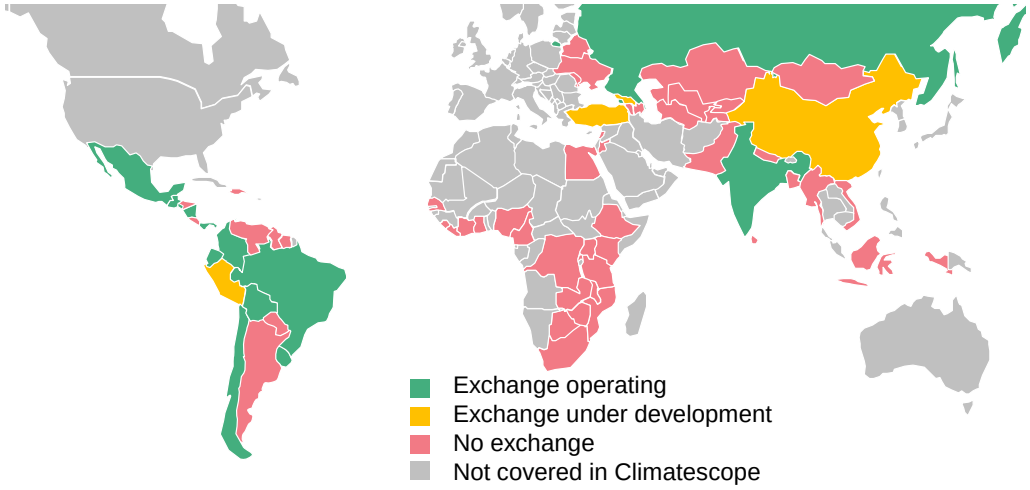
Wholesale markets and renewables dispatch

Relatively few of the 71 Climatescope nations have wholesale power exchanges compared with OECD countries (Figure 33). Power exchanges aim to ensure transparent and reliable wholesale price formation by matching supply and demand, starting with the lowest-cost generator. They also insure that trades done at exchange are executed and paid.

An important hurdle to wider adoption of wholesale markets in developing countries is that the potential volumes of electricity to be traded are limited and the number of potential trading participants rather small. Both make it hard to justify the time, effort, and cost of establishing an exchange. There is also the risk that one player might dominate a tiny market.

As discussed, renewables growth tends to correlate directly with the presence of multiple generators competing on price (Table 4). Wholesale markets foster such competition and ensure that what clean generation is on the grid gets used optimally. The price signals delivered by the exchanges are essential indicators for market participants and regulators alike to understand supply/demand balances across days, weeks, seasons or even geographies if nodal prices are used (see Figure 32 for the example in Mexico). These are critical feedback loops for policy-makers wishing to understand the impact of adding large volumes of renewables and mitigating risks of poor forecasting and over procurement.

Figure 33: Wholesale power exchanges in emerging markets



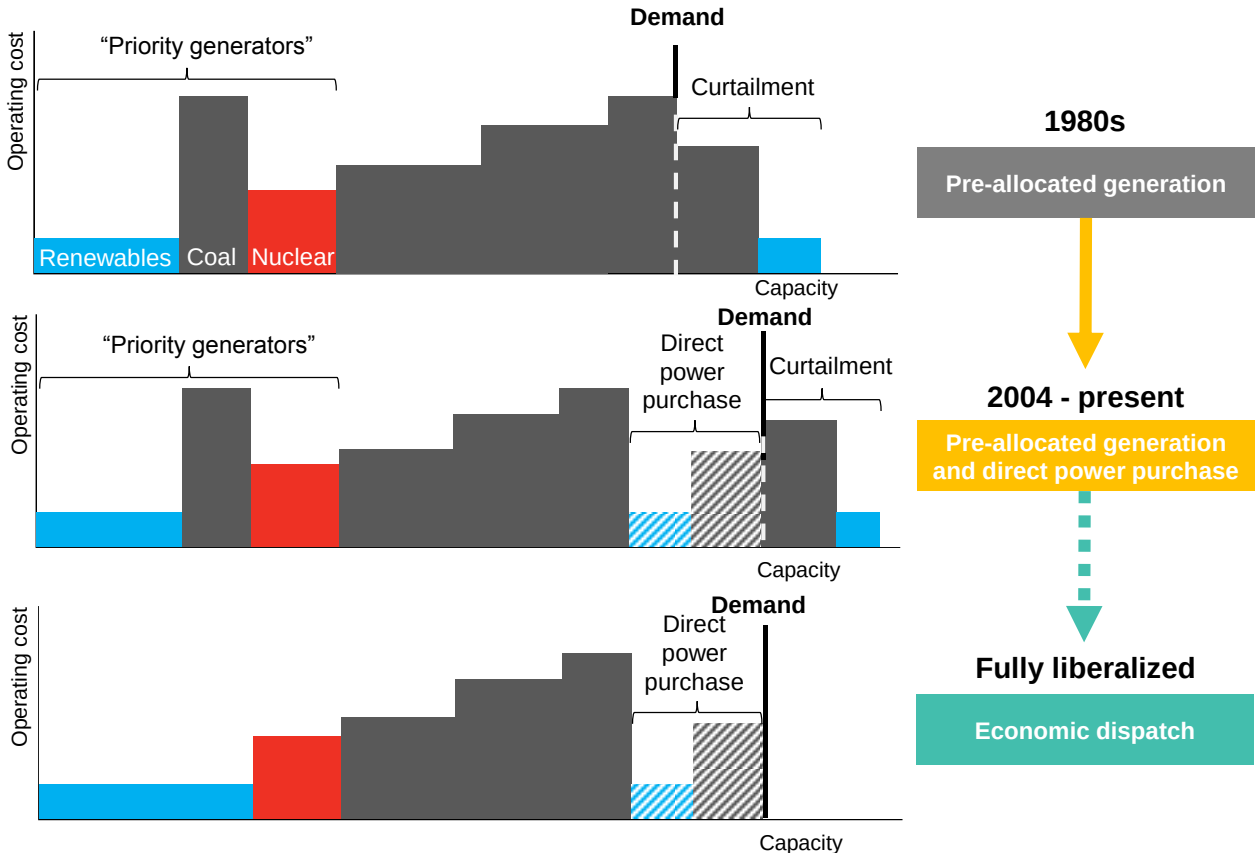
Source: Bloomberg New Energy Finance

[16] Mexico a total of 11 interconnections with the US, being two with CAISO, three with WECC and six with ERCOT.

Another essential feature of wholesale power exchanges is that their clearing mechanisms are generally based on the principal of rewarding least-cost marginal units of power. As renewables typically have near zero operating costs, they are usually the first dispatched, before nuclear, coal or gas. This allows clean energy consumption to be maximized within the constraints of demand and available transmission capacity.

Nowhere are the economic and environmental benefits of truly open wholesale power exchange ready to be realized more than in China, home to the world's largest power grid and 244GW of renewables capacity. Currently, China's electricity market is essentially semi-liberalized. The price of power to be delivered from generator to distributor can be negotiated but the volumes of power to be sold cannot. Instead, they are set by regulators annually using quotas. That stands potentially to change gradually (Figure 34) and when it does, a far more fluid and flexible market will be born.

Figure 34: Illustrative power dispatch mechanisms in China



Source: Bloomberg New Energy Finance

For now, however, provincial power capacity development plans are dictated by expected economic growth rates outlined in government Five Year Plans, and dispatch quotas by local government on an annual basis. Given that predicting how quickly Chinese GDP will expand is always difficult and that the relationship between economic growth and electricity demand is tenuous, this is a deeply flawed system. Not surprisingly then, large volumes of clean energy generation go wasted in China while power continues to get bought from even the least efficient coal plants.

China is expected to tiptoe toward implementing a truly liberalized wholesale power exchange over the next decade as the country battles air pollution and seeks to meet its renewables and emissions goals. Achieving an orderly transition to an open market would be a transformative and remarkable achievement considering the role China's coal sector has played in powering the country's economic boom. It is also far from certain the country will complete the process of liberalization given competing economic and political forces at play.

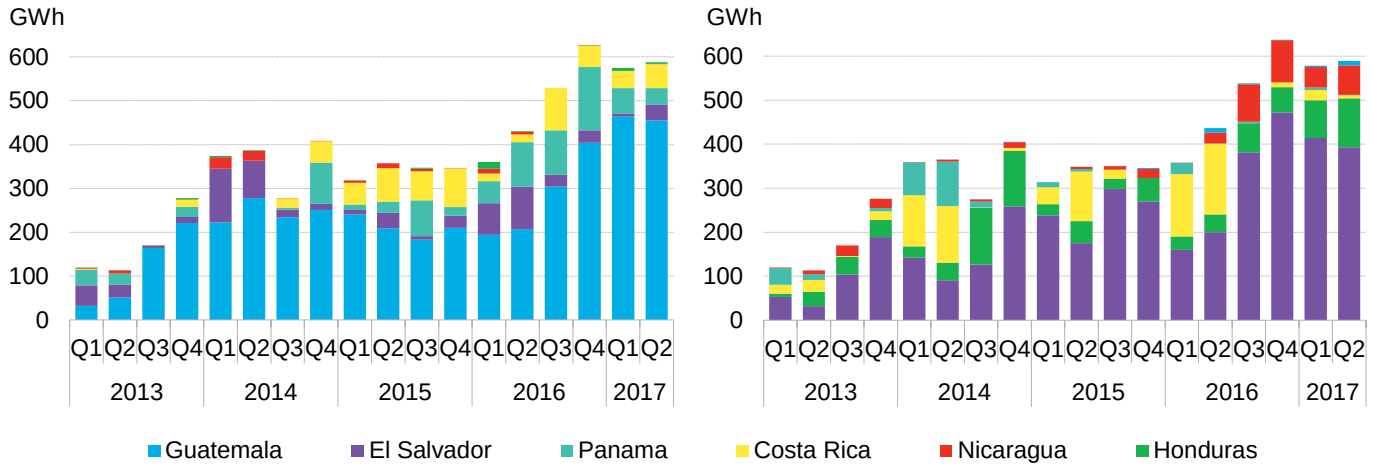
Cross-border grids and renewables integration

Wholesale power markets are not required for cross-border exchanges of power to occur, but they do help facilitate such trades. Indeed, the change of prices in interconnected wholesale power markets are the best indicator of which market is in a position to export or import power at any given time. Efforts to interconnect power markets across countries and regions are growing throughout the world as policy-makers and regulators recognize their contribution to system resilience and renewables integration.

In the EU, member states are targeting to reach interconnection capacity at least equivalent to 10% of their individual installed capacity by 2020, for instance. Interconnections played a critical role in allowing European system operators to face the challenge of the 2015 solar eclipse which caused solar power generation to fluctuate massively as darkness made its way across the region in the middle of the day.

One of the most advanced regional grid integration efforts in developing countries is the SIEPAC grid, which spans seven countries in Central America and is facilitated by the Mercado Eléctrico Regional (MER) power exchange. Interconnection between these tiny countries has existed for many years, however, cross-border flows really ramped in 2013 once the MER was implemented alongside rules that enabled generators and distribution companies to clearly benefit from access to a larger power pool. Since 2013, activity on the MER has grown almost continuously and has allowed around 7TWh to be traded across the region (Figure 35).

Figure 35: Central America power market exports (left) and imports (right)



Source: Ente Operador Regional, Bloomberg New Energy Finance

Regional integration has significantly contributed to energy security, affordability and renewables integration in MER's seven country members. Guatemala is the region's top net power exporter, with 706GWh or 6% of the electricity generated in the country finding revenue in interconnected

markets in 2016. Meanwhile El Salvador, the largest importer, has been able to rely on 740GWh of imports in 2016, equivalent to 13% of the electricity generated in the country that year. And there are signs that benefits are already feeding back to end consumers and the environment. Five of the seven countries in the region saw retail prices fall since 2013, and three have been able to reduce the utilization of their fossil fuel generation fleet.

Other less advanced regional market integration initiatives exist across the world but are often slowed by the complex geopolitical relationships between neighboring states, or simply by the scale of investment and effort required. Japan's Masayoshi Son recently expressed hope to revive plans for a regional "megagrid" connecting Japan, South Korea, China and Russia. In Sub-Saharan Africa, three regional power pool projects for the Western, Eastern and Southern region of the sub-continent are slowly being developed. Some of these projects may well accelerate in the future as countries aim to smooth the integration of growing renewables generation.

Renewables deployment and power sector financial balances

Long-term power contracts with fixed price guarantees are critical to clean energy development. A typical wind or solar project requires virtually all its capital upfront to fund construction, making access to affordable financing essential. Many commercial banks have expanded into renewables and improved the terms of debt agreements as the sector has matured over the last decade. But financing is generally available only to projects that can prove they can sell their power at a sufficiently high rate over a sufficiently long period of time to a sufficiently reliable buyer (i.e. the utility), in other words, that have received some sort of subsidy.

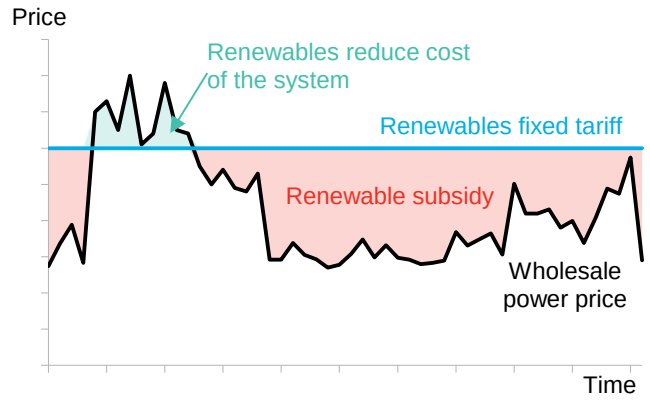
Energy subsidies and economic cycles

However, it is not just the financial community that takes risk in supporting clean energy development. When awarding fixed contracts to renewables projects, governments are making long-term commitments to make pay out at certain rates, even if wider market conditions change dramatically.

Here too, wholesale markets allow for a better visualization of these dynamics (Figure 36). The volume of subsidy to be awarded to renewables is determined by the difference between the wholesale power price, or the cost of procuring electricity at any one time in the system, and the fixed tariff awarded to renewables. To date, that difference has tended to be negative but it can also be positive as renewables are becoming more competitive. The fluctuating nature of renewable subsidy budgets can bring about major challenges for policy makers when power market supply and demand dynamics are not well understood. Indeed, if large amounts of renewables are added to a system that is already at capacity or if a market goes through a major downturn in demand, then wholesale power prices will fall, mechanically increasing the subsidy budget.

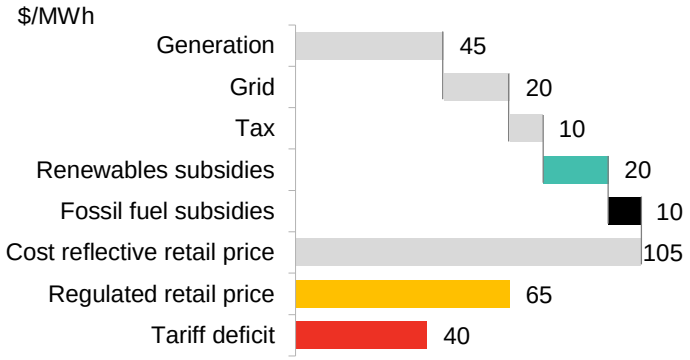
The issue of ballooning subsidy bills can be managed so long as funding is well organized. For example, in Europe, most markets that socialized the cost of subsidies by funding them through explicit levies on the consumption of fossil fuels or retail electricity bills avoided retroactive cuts of renewables subsidies. Countries that accumulated an unfunded budget deficit on the other hand reduced support retroactively, shaking investor confidence. This issue is also materializing in emerging markets that have deployed massive amounts of renewables.

Figure 36: Renewables tariffs and wholesale power prices



Source: Bloomberg New Energy Finance

Figure 37: Retail tariff structure



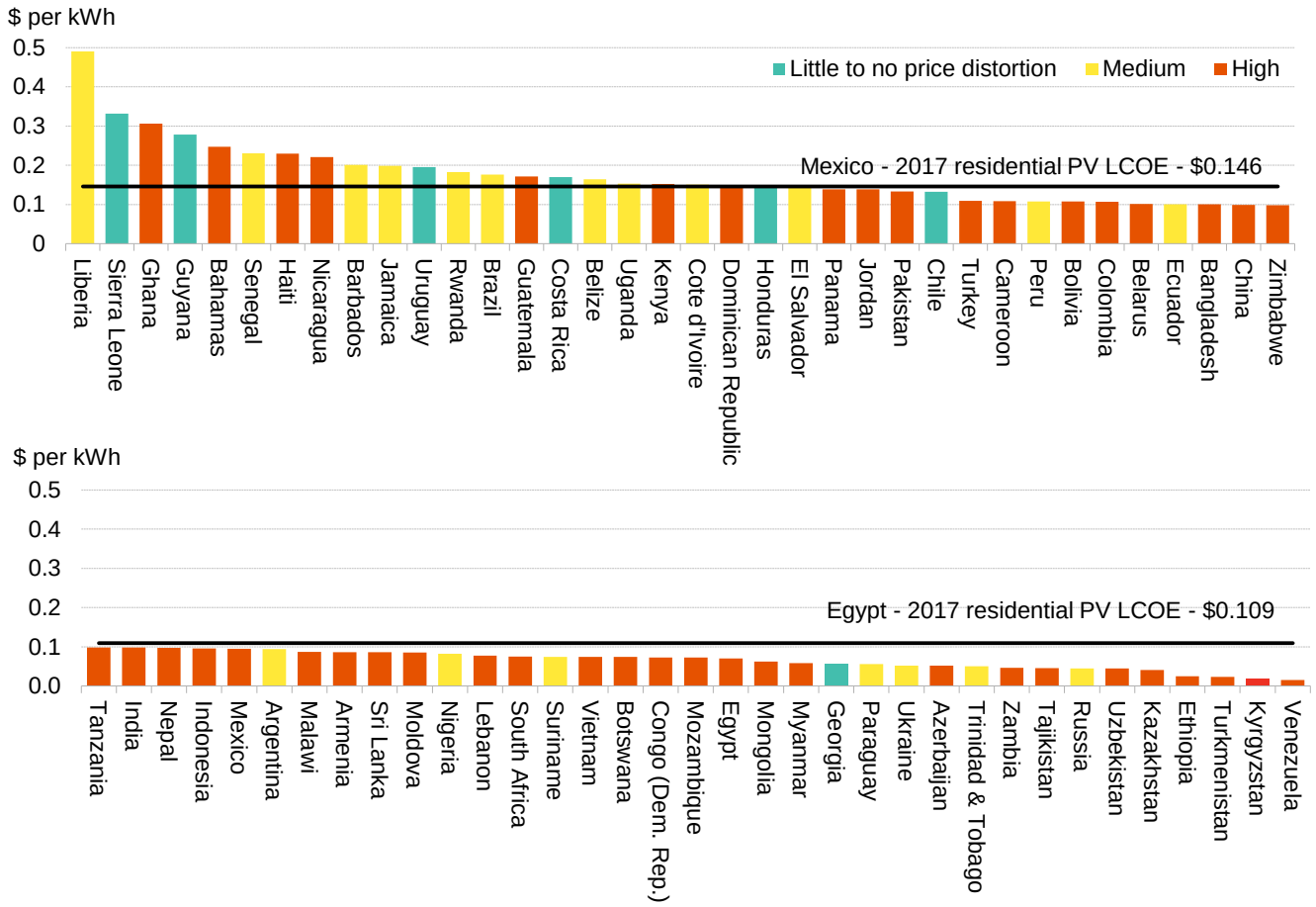
Source: Bloomberg New Energy Finance

China, for example, has subsidy commitments towards renewables developers in excess of $15 billion a year as of 2017 which are supposed to be funded through a $27.49MWh levy on industrial and commercial retail electricity prices. However, the revenue generated from the levy falls short of the total subsidy bill and the country's renewable energy fund is accumulating debt owed to renewables developers who are now awaiting payments. Figure 37 shows how subsidies for fossil fuels, renewables and on retail power prices impact the financial balances of an energy system and can lead to the creation tariff deficits. One solution: increase the levy, or extend it to cover the agricultural and residential sector. However, China's government is wary of the impact this could have on the competitiveness of its industry and the response of the population.

Regulated retail prices and off-taker risk

Politicians worldwide are well familiar with the political challenges caused by rising retail power prices rise. In emerging markets, with their lowest-income households, this is particularly true. So it is unsurprising that many of these nations have enshrined subsidies intended to keep power prices in check. All but seven of the 71 countries reviewed in Climatescope have regulations in places that distort and lower retail power prices.

Figure 38: Residential power prices in Climatescope countries and select residential levelized costs of electricity for residential photovoltaic systems

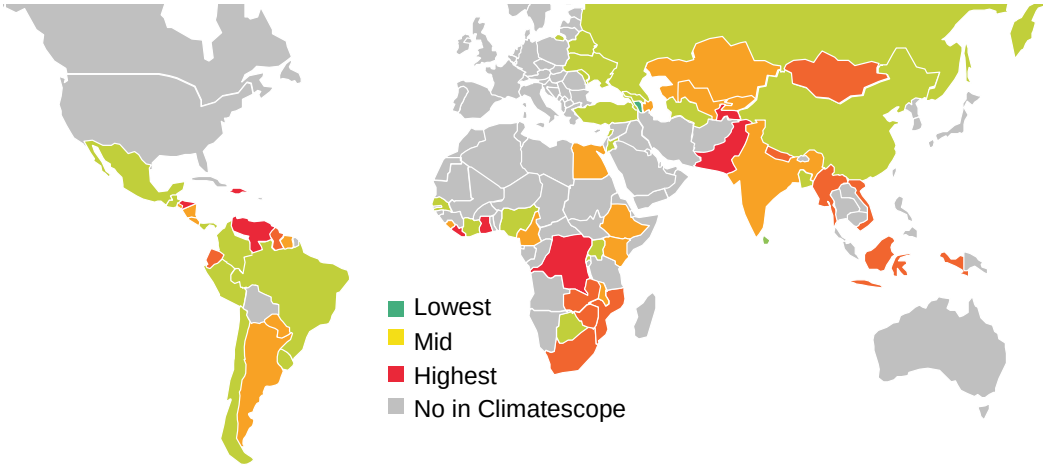


Source: Bloomberg New Energy Finance

In the majority of countries, deficits created by these subsidies land on the books of state-owned utilities. In the best cases, budget holes are plugged by cash injections from government budgets. In most cases, however, the shortfalls simply create financial distress for utilities.

This, in turns, creates increased risk for developers looking to sell their power to the utility and get reliably compensated. Climatescope assesses and rates off-taker risk in each of its countries by reviewing the financial positions of utilities and whether its national government has historically plugged budget holes with capital injections (Figure 39).

Figure 39: Off-take risk in Climatescope countries



Source: Bloomberg New Energy Finance. Note: BNEF assessed offtaker risk as part of the Climatescope project, taking into account the relevant company's financial history, sovereign guarantees and perception among players in the market. See full methodology.

The map highlights the relatively high risks all across emerging markets, with Sub-Saharan Africa and Central Asia particularly challenging. However, these regions are also home to two important examples of how public-policy interventions can reduce off-take risk and spur clean energy growth.

Utility successes in Senegal and Tajikistan

Senegal relied on imported oil for no less than 86% of power generation until 2014, forcing the government to fund an estimated $200-250 million tariff every year to keep electricity affordable to low-income consumers depending on oil prices. The government seized the opportunity presented by lower crude prices to improve the financial position of its utility by allowing it to grow revenues by slowly increasing retail power prices, and further reduce its power procurement costs by tendering renewables capacity to reduce the dependence on fossil fuels. The tenders jump started clean energy investment in the country which attracted $419 million over 2015-2016 and saw its Climatescope score jump from 0.59 in last year's survey to 1.68 this year. That marks the single highest year-on-year increase across all countries.

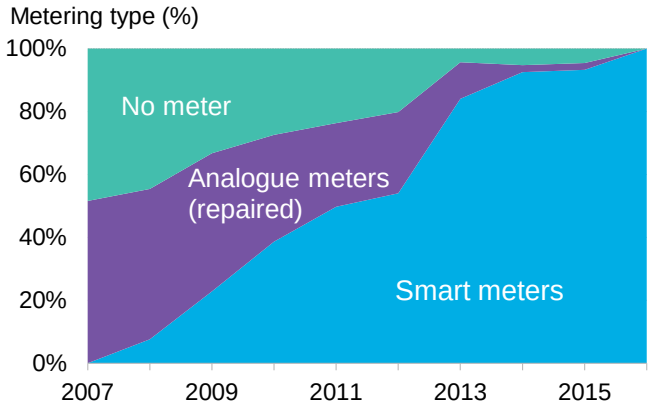
The other success story comes from one of the most remote areas of Tajikistan. In 2002, Pamir Energy, a public-private partnership supported by the Tajik Government, the World Bank Group, the Swiss State Secretariat for Economic Affairs (SECO) and the Aga Khan Foundation (AKFED), was awarded a 25-year concession granting it a monopoly over generation, transmission and retail of electricity in the Gorno-Badakhshan Autonomous Region, the largest, poorest and most mountainous region in the country. Electricity losses in the system were as high as 40% and just 13% of the population had access to unreliable electricity sold at the extremely low regulated tariff of $0.02/kWh tariff. Despite the low prices, collection rates rarely exceeded 60% and electricity theft was common.

Since receiving its concession, Pamir has restored 11 micro-hydro plants, bringing 42MW of capacity back on line, and upgrading 4,300km of transmission lines. However, it has been fixes to the distribution network that have proven most essential to the project. With the help of the smart metering manufacturer SECO, Pamir launched a new electricity tariff structure incentivizing

energy savings and guaranteeing affordability to the poorest households. Pamir rolled out smart meters that remotely provide reliable consumption data collection and allow for the interruption of service when customers fail to pay.

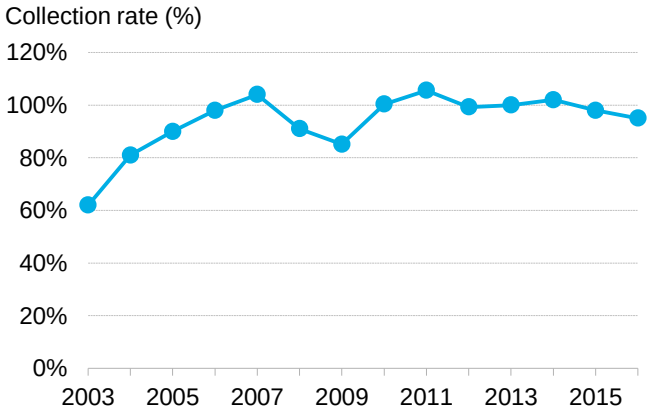
The pace of the smart meter roll-out and the impact it has had on collection rates in combination with new tariff structure and 24 hours service availability has been staggering (Figure 40 and Figure 41). In contrast to the incumbent utility it replaced, Pamir's cash flows have been positive since 2009. This transformation has decisively contributed to the socio-economic development of the region. The number of SMEs in the area has jumped 53% since Pamir took over the concession, further contributing to revenue growth for the utility.

Figure 40: Pamir Energy (Tajikistan) re-metering program



Source: Pamir Energy, Bloomberg New Energy Finance

Figure 41: Pamir Energy (Tajikistan) sales collection rate



Source: Pamir Energy, Bloomberg New Energy Finance. Note: Collection rates larger than 100% are indicative of when the utility recovers arrears.

From a technical perspective, the impact achieved by Pamir is replicable in other emerging markets. However, the approach of Pamir requires considerable investment in changing the culture of power sector stakeholders, from the utility to the end consumer.

Off-grid solutions to address utility failures

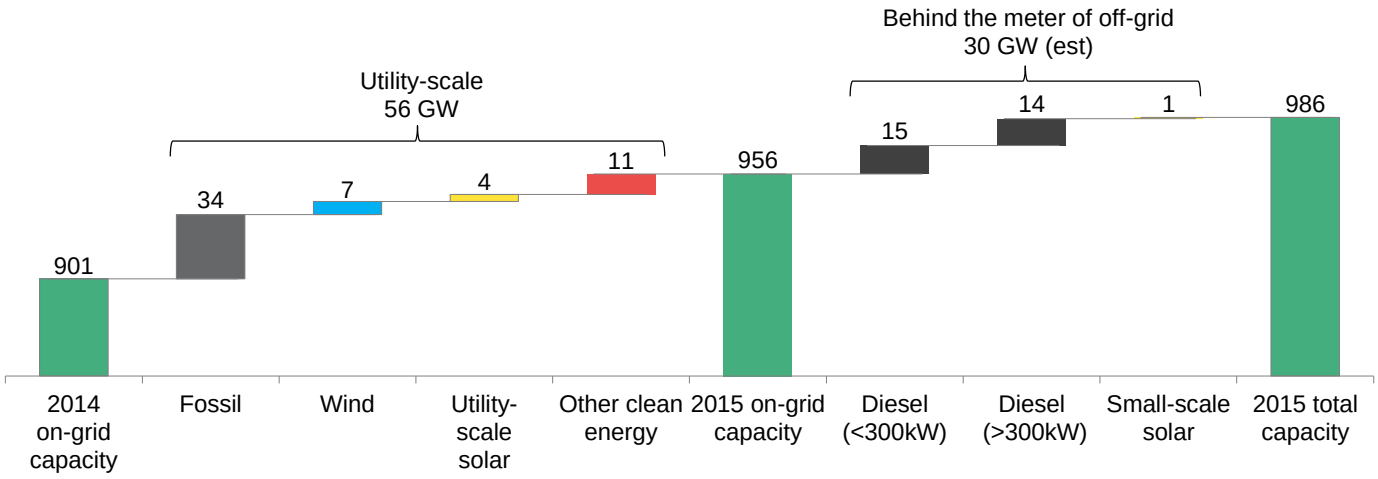
Dramatic cost declines for renewables and innovation in IT have created expanded opportunities to provide energy services to populations with no grid access, and to those that suffer from unreliable or excessively expensive electricity services.

In Africa, financing for small-scale solar projects, including debt for distributed portfolios, accounted for five of the 11 largest solar transactions BNEF tracked from January to October 12, 2017. This is not necessarily because off-grid financing is a large market, but because so many utility-scale projects in the pipeline struggle with permitting, land acquisition, power purchase agreements and financing. Off-grid solar companies may be able to move faster because they do not require regulated tariffs.

Still, diesel generators have long been the technology of choice in areas where reliable grid electricity is unavailable. In 2015, developing countries bought and installed about 600,000 units annually, totaling an estimated 29GW of capacity. About half of this is in units smaller than 0.3MW. There is a mature market and supply chain to sell, fuel and maintain this kit. Despite

usually being competitive with diesel, solar currently has less than 3% of the market for distributed energy capacity in developing countries, well short of its potential (Figure 42).

Figure 42: Power capacity additions in developing countries in 2015



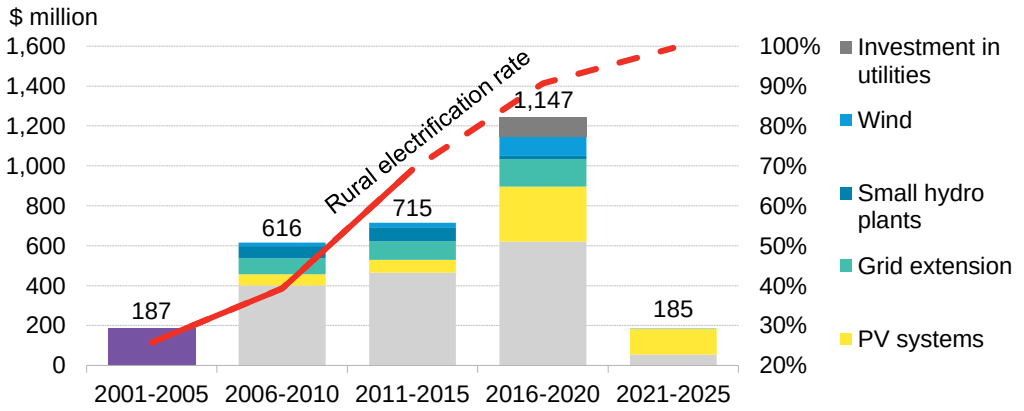
Source: Bloomberg New Energy Finance, PGS Consulting. Note: Developing countries includes the majority of non-OECD countries excluding China, Russia and other non-OECD countries with very reliable electricity grids. 2015 is the last year for which complete data is available.

Most truly off-grid activity to date has been led by entrepreneurs, impact investors and venture capitalists deploying innovative solutions at smallest scale. Governments can be helpful to these efforts or simply bystanders.

Climatescope profiles a numbers of nations that have set ambitious targets for off-grid electrification. **Peru**, for example, managed to rapidly boost rural electrification rates thanks to its well organized and adequately funded plan. The country published its General Rural Electrification Law in 2006, allocating $1.3 billion split across mini-grids, PV systems, grid extensions, small-hydro plants, wind projects and investment in utilities to strengthen their rural electrification efforts. As a result, from 2006 to 2015, Peru extended electricity access to 3.4 million people, raising its rural electrification rate from 29% in 2006 to 78% in 2015 (Figure 43). The government is now focused on providing full access by 2025.

Key to Peru's success has been the government's recognition of the changing roles each component of its strategy can play over time as technology costs evolve and as conditions change between regions. For example, the cost of mini-grids rises the further villages are located from central infrastructure and the smaller demand is. Meanwhile, the costs of solar systems has dropped by three quarters since the program started. Both trends were taken into account when developing the electrification budget for 2016-2020. More funds were made available for PV systems through an auction awarding a contract to supply and operate the systems. Under the arrangement, winner and private developer Ergon Peru must install 150,000 PV systems by July 2019.

Figure 43: Peru rural electrification budget and rural electrification rate



Source: OSINERGMIN, Bloomberg New Energy Finance. Note: 2006-2015 budget break-down was estimated based on Peru's national enegy plan 2004-2013 and PNER 2009-2018.

Taking a page from Peru's book, **Rwanda** is now one of the most welcoming countries for off-grid development. It aims to boost electricity access from 30% in 2017 to 70% by June 2018. Under the plan, almost a quarter of the population is to be given access through off-grid solutions, despite just 3% having such access today. To achieve its goal, the Ministry of Infrastructure is also planning to award a contract to an off-grid PV systems distributor via tender. The winner will have exclusive rights to supply fully subsidized systems to the poorest 15% Rwandan households.

Electrification through micro- and mini-grids activity is also picking up steam with 35 projects announced globally in the first three quarters of 2017 vs. 13 completed over the same period in 2016. Mini-grids hold the promise of delivering reliable electricity services at scale, potentially providing electricity to more substantial economic activity. However, projects that can provide continuous power by integrating a storage or diesel back-up systems remain relatively costly relative to resources currently available. Such projects also require conducive regulatory schemes and financial support to succeed.

A mini-grid project on Lake Victoria's Kitobo Island in **Uganda** illustrates the economic and regulatory challenges faced by developers. In 2015, Uganda's Electricity Regulatory Authority (ERA) granted Italian mini-grid developer Absolute Energy a framework concession to build on 23 Ssese Islands in Lake Victoria, and a license exemption specifically for Kitobo Island, where the company has built its first micro-grid. The developer erected a 230kW/520kWh solar, storage and diesel micro-grid on Kitobo for $1.4 million to serve a fishing community.

In the absence of a nation-wide micro-grid retail tariff framework, rates are negotiated on a site-by-site basis and ERA has not approved the company's plan to sell power locally at rates higher than those offered by the utility. Absolute's operating costs on Kitobo are three times its revenue per kWh, BNEF estimates. As result, the $0.2675/kWh tariff ERA has authorized that is also applicable on the country's main grid will not yield sufficient cash flow for the project to break even for at least 10 years.

In the most far-flung off-grid locations, simply adding power supply does not necessarily create sufficient economic growth and associated customer demand to justify tariffs at above utility rates. On Kitobo, demand has been lower than hoped as some locals have declined to sign up. In

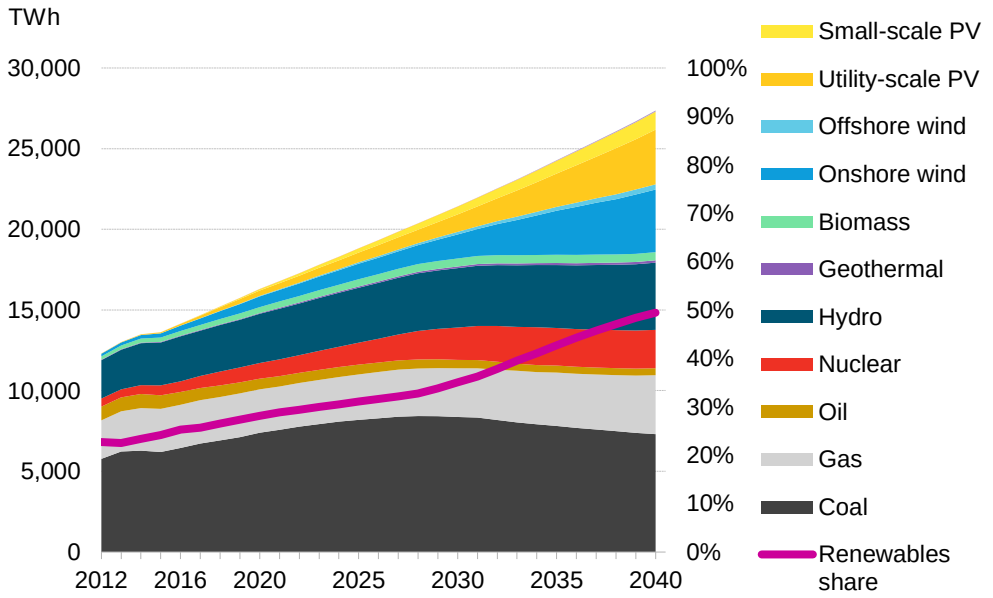
response, the developer is seeking other demand sources to consume output generated at the sunniest, highest producing hours. This has included ice-making and nut-grinding facilities.

3.3. The future of clean energy policy in emerging markets

When looking at the story of Latin American countries, Brazil, Chile and Mexico in particular, or to China and India, it is clear that emerging markets are making a decisive contribution to the global energy transition away from fossil fuels towards an emission free power system. And their commitments are not limited to the electricity sector.

China and India, the two largest consumer markets in the world, have committed to the most ambitious electric vehicle sales targets set globally. China is working on the introduction of a carbon market. India could soon follow with recent air pollution levels in New Delhi frequently climbing to levels 12 times over the maximum limit set by the World Health Organization. Latin American countries, led by Brazil, have pledged unconditionally to reduce their emissions by 2030 under the Paris Agreement despite ambitioning to continue to grow their economies at rapid pace. In the Middle-East, Jordan, a country that has not been able to rely on vast fossil fuel resources like most of its neighbors is paving the way in the large-scale deployment of renewables. And markets across Sub-Saharan Africa are starting to leverage the solar cost revolution with the aim of leapfrogging some of the fossil fuel and transmission grid investments typical of past growth models.

Figure 29: Non-OECD economic electricity generation forecast



Source: OSINERGMIN, Bloomberg New Energy Finance.

The continuation of the renewable technology revolution stands to radically transform the energy mix of future economic growth. BNEF's 2017 New Energy Outlook forecasts that non-OECD countries will reach an impressive 50% of renewables in generation by 2040 if the economics of different technologies are left to play out against each other without policy intervention (Figure 29). The removal of policy from the forecasts is of particular relevance in non-OECD countries as too often governments there are slow in recognizing the seismic shift brought about by cheap renewables, often with the aim of protecting the interest of incumbent monopolies.

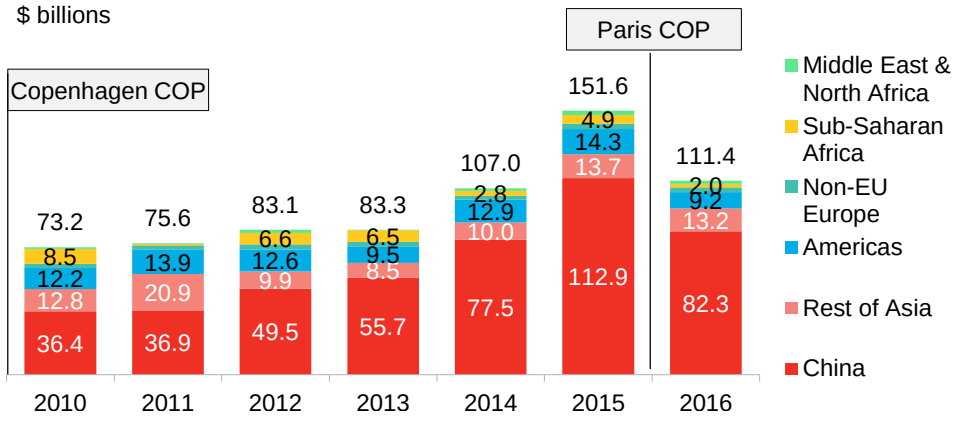
Even under BNEF's long-term view, there is not nearly enough zero-emissions generation added to put the world on a 2-degree trajectory. BNEF estimates that around 10.9TW of clean energy will need to be deployed on top of the around 7TW forecasted on economic grounds. Such additional build will require new policies and $14.1 trillion of investment into zero-carbon power generation between 2016 and 2040. The majority of this will need to be deployed in non-OECD countries to replace economic fossil fuel capacity additions.

Section 4. Emerging Market Clean Energy Investment

Since 2010, emerging markets have accounted for a larger share of global clean energy investment than the rest of the world. But from 2015 to 2016, these countries recorded their deepest year-on-year decline ever, in dollar terms. This analysis reviews clean energy financing in 106 emerging market nations and explores why capital flows appear to have slowed recently.

- Total worldwide investment in clean energy recorded its largest year-on-year drop (in dollar terms) in 2016. But developing countries accounted for a disproportionate portion of the decline, with asset (project) financings there falling from $153.8 billion to $103 billion.
- China accounts for the lion's share of clean energy asset finance in developing countries and attracted 63 percent of all such capital over the last decade. The country saw investment slip by $30.6 billion or 27 percent, 2015-2016.
- However, others saw steep declines as well. Excluding China, investment fell 30 percent in 2016 in the nations surveyed. Brazil, India, Turkey, Mexico and South Africa complete the top six emerging markets nations for clean energy and have attracted $270 billion since 2010.
- Despite large total volumes of capital deployed since 2010, a number of emerging markets have seen little to no investment. In any given year since 2010, no more than 27 developing countries have attracted over $100 million to build a single utility-scale wind or solar project.
- Thanks largely to China, the majority of total clean energy project finance in emerging market nations is provided by the countries themselves. The China Development Bank, state-owned enterprises, and private Chinese companies have all helped fund the build-out.
- Elsewhere in emerging markets, however, "international" (non-domestic) capital has played a critical role in scaling growth. No less than 36 percent of the funds deployed to the 106 emerging market countries in 2016 came from abroad (China excluded).

Figure 44: Clean energy asset finance in emerging markets, 2010-2016



Source: Bloomberg New Energy Finance

- Wealthier nations accounted for the majority of these international flows. However, after growing from $2.7 billion in 2007 to $13.5 billion in 2015, OECD-country funding suffered its largest year-on-year decline in 2016 to $10 billion. Funds awarded by development banks have stagnated at around $4 billion since 2014.
- Latin America has attracted the largest and steadiest flow of investment from overseas funders, topping $3 billion every year since 2010. The region has benefited from the use of tenders for clean power delivery contracts, which provide investors greater market certainty.
- The recent slowdown is potentially troubling news for policy-makers as it comes eight years after developed nations pledged to commit $100 billion annually by 2020 to lesser developed countries to address climate change. That promise was reiterated at Paris two years ago. However, there is little to suggest that long-term goal is near to being met.

4.1. Clean energy investment slows

Explore the cross-border clean energy asset finance in emerging markets data at the heart of this analysis with our web toll (LINK).

Since 2010, developing countries have collectively accounted for a larger share than wealthier countries of clean energy asset finance, a category that includes capital for wind, solar, geothermal, biomass and small hydro projects. Given that the majority of clean energy investment in any year is asset finance, these nations have effectively spearheaded overall growth in the sector for some time (Figure 45). China has recently become the global center of gravity for such activity, accounting for over a third of all such investment recorded from 2010-2016 (Figure 46).

From 2015 to 2016, total worldwide investment in clean energy saw its sharpest drop ever recorded by Bloomberg New Energy Finance in dollar terms. Total capital flows slipped from $348.5 billion to $287.5 billion while asset (project-related) finance fell from $237.4 to $187.1 billion, or 21.2%. Developing countries saw the largest fall, with asset financing dropping from $153.8 billion to $103 billion, or 33%.

China was, of course, a huge part of the story. It accounted most to the slowdown with its clean energy asset finance activity falling 34.1% from 2015 to 2016. China was not alone among emerging markets, however. Across all other developing countries, total investment dropped from a record of $43.3 billion in 2015 to $30.2 billion in 2016.

Figure 45: Clean energy asset finance

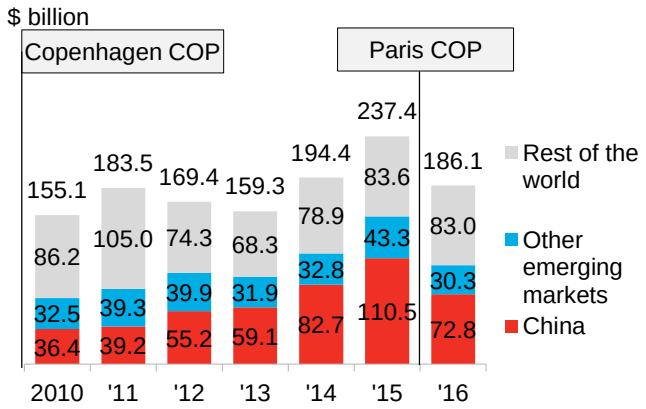
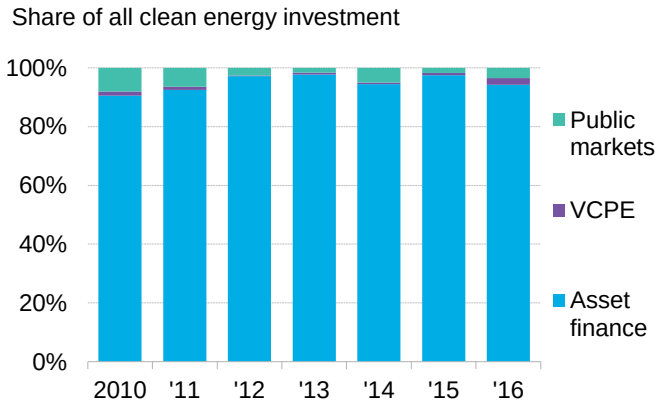


Figure 46: Emerging market clean energy investment channels

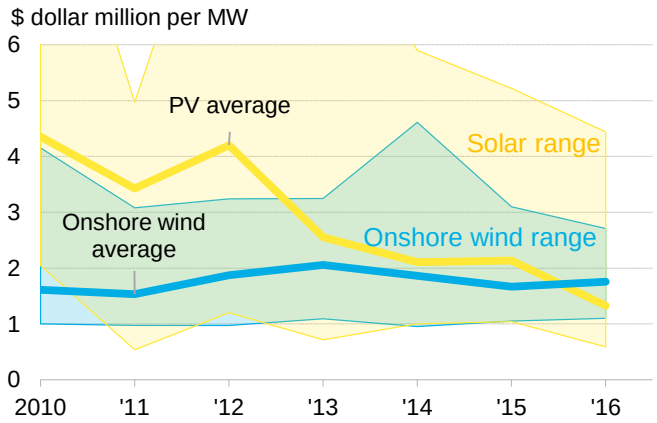


Source: Bloomberg New Energy Finance. Note: "Rest of the world" includes OECD nations minus Chile, Mexico and Turkey which are accounted for in "Other emerging markets".

Source: Bloomberg New Energy Finance. Note: Public markets represent funds raised over public exchanges. VCPE is venture capital and private equity. Asset finance is capital raised for both large- and small-scale new energy projects.

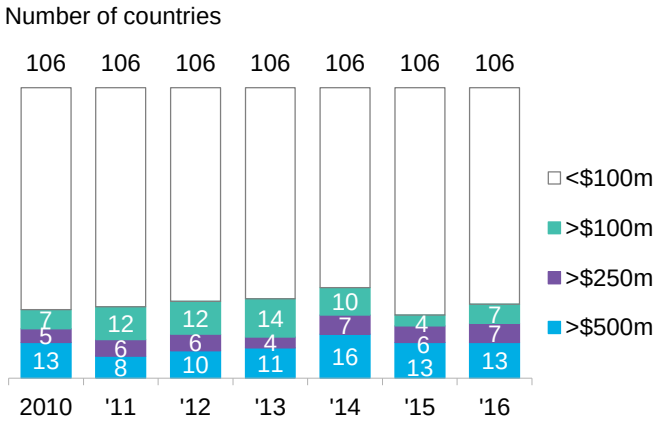
The large drop in activity recorded globally – and in developing nations in particular – is potentially troubling news for policy makers on the eve of the two-year anniversary of the landmark Paris Agreement and the start of the next round of UN-organized climate negotiations in Bonn, Germany. This pronounced investment drop also comes just three years ahead of 2020, the year in which total wealthy nations pledged to start delivering $100 billion annually to poorer countries to address the threat of climate change.[17]

Figure 47: PV and onshore wind capex in developing countries



Source: Bloomberg New Energy Finance

Figure 48: Developing countries by asset finance volumes



Source: Bloomberg New Energy Finance. Note: Chart depicts the total number of nations that were able to secure certain thresholds of financing in given years.

Clean energy costs generally, and solar costs particularly, have fallen sharply in recent years, which in turn has depressed asset finance values globally. This has been true in the most mature and competitive renewables markets, including many developing countries such as China, India and those in Latin America.

Still, total construction costs (capex) in emerging markets tend to be higher than in more developed countries, reflecting local currency or political risks, higher costs of financing, and often lack of access to equipment. The result is that in a number of parts of the developing world the effect of global clean energy technology cost declines has been somewhat muted to date.

In fact, capex costs vary massively across emerging markets (Figure 47) and this wide range is likely to remain for some time as the number of countries recording regular and significant levels of clean energy investment remains relatively low (Figure 48). In any given year since 2010, no more than 27 developing countries have seen over $100 million invested into clean energy out of

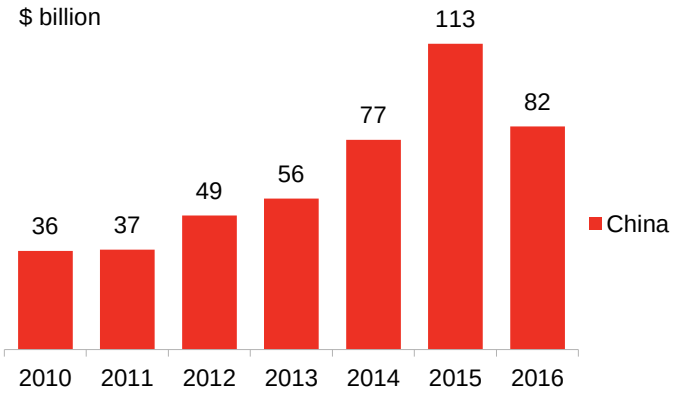
[17] The pledge made by wealthier countries at the Copenhagen climate talks in 2009 was to deploy $100bn per year to help poorer nations address all aspects of climate change, including both mitigation and adaptation. That is much broader than simply clean energy finance flows. Still, renewables stand to play a critical part in mitigation, particularly as these countries seek to grow their economies and expand their consumption of electricity.

the 106 reviewed in this analysis. Less than half have recorded more than $500 million of clean energy investment cumulatively over 2010-2016. That $100 million is approximately enough to build one typical medium to large onshore wind or PV project. Such results suggest most developing countries have yet to attract consistent volumes of capital to scale their local clean energy sectors, achieve economies of scale, and drive down costs in the way that wealthier nations have to date.

China and the other Big Five

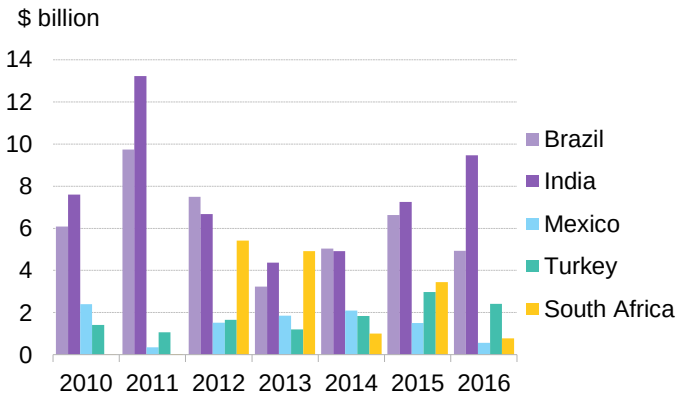
As discussed, China accounts for the lion's share of clean energy asset finance in developing countries in any given year and the country attracted 63% of all such capital over the last decade (Figure 45 and Figure 49). But others have generated significant investment as well. Brazil, India and Turkey have all recorded at least $1 billion of investment in new asset finance every year over the last ten (Figure 50). Mexico and South Africa, which complete the top six, saw more patchy investment in line with cycles in government policy or integration challenges. South Africa attracted $5.4 billion of new investment on the back of its clean energy auction program in 2012. This year, Mexico is on pace for a record having generated $3.7 billion of investment in just the first six months into 2017.

Figure 49: Clean energy asset finance in China



Source: Bloomberg New Energy Finance

Figure 50: Clean energy asset finance in the next five largest emerging markets



Source: Bloomberg New Energy Finance

Patchy clean energy investment flows are common across emerging markets, particularly the smallest and least developed countries. However, even larger, lesser developed nations have seen patterns of start-stop, albeit for different reasons.

In countries such as China, Brazil or Indonesia, slower than anticipated power demand growth and better than expected improvements in energy efficiency led regulators to over-procure new power generation of all kinds. This depressed opportunities for new renewable and fossil-fuel based development alike. Meanwhile, in South Africa, poorly managed and financially distressed utility ESKOM has struggled to keep up with levels of deployment and to make the associated contracted payments. This has also affected renewables deployment in certain Indian states where the local distribution companies are also going through financial distress

The importance of international finance

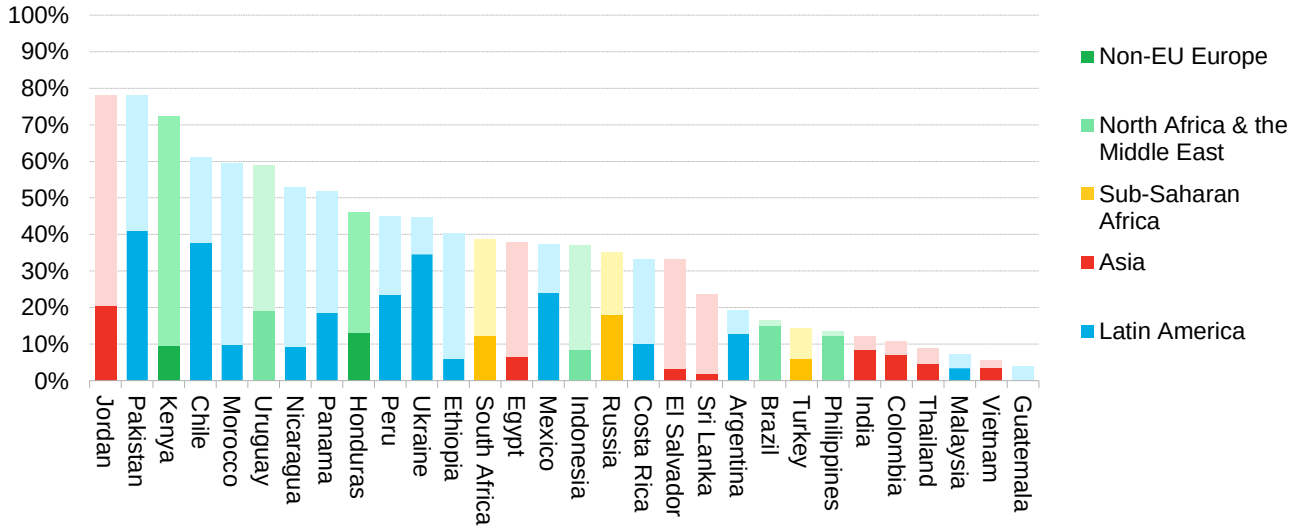
A major difference between China and most other developing countries is that it offers relatively few opportunities for international investors to participate. This is due both local ownership and

content rules that favor wind, solar, and other projects that are outfitted with equipment manufactured on Chinese soil and due to the saturation of the market by domestic financiers, including state-owned utilities, development banks and others. The $4.8 billion of overseas capital China attracted for its clean energy projects over the last decade represent just 1% of all such investment in the country over that time.

Considerably more opportunities exist for investors to deploy capital into developing nations, however. In fact, it is not uncommon for foreign capital to account for the majority of funds deployed in certain emerging markets (Figure 51). Pakistan, Jordan, and Kenya in particular have all successfully attracted the interest of international financiers in recent years.

Figure 51: Top 30 emerging markets that attracted the largest share of foreign clean energy investment, 2010-2016

Share of foreign equity (dark) and debt (faded) in total clean energy asset finance



Source: Bloomberg New Energy Finance. Note: top 30 of 106 emerging markets surveyed.

In Pakistan, demand for new power-generating capacity is strong and the country has successfully implemented a feed-in tariff for new renewables. Both have helped boost foreign investment from Chinese developers and from the U.S. Overseas Private Investment Corporation (OPIC). Likewise, Kenya's feed-in tariffs have helped it secure investment from broad group of private and public investors, notably for the Lake Turkana wind power project which brought together a broad group of investors including Aldwych, the Industrial Fund for Developing Countries, Vestas or Norfund. In Jordan in 2012, the government established its Renewable Energy and Efficiency Law, which authorized the holding of multiple tenders for clean energy supply contracts. This, in turn, successfully encouraged the European Bank for Reconstruction and Development and the World Bank to finance wind and solar activity in the country.

International investor strategies tend to be dictated by their own return expectations and by the level of risk offered by the country they are considering investing in (Table 5). In typical project finance in developed nations, projects with lower risk tend to be able to take on more debt, while those most risky tend to require a greater proportion of equity. But in the context of emerging markets, this basic rule of leverage does not necessarily hold true. In fact, thanks to the critical role development and public finance institutions play in the very riskiest emerging markets,

projects in such countries can at times be funded entirely with concessional debt as commercial financiers will often take a pass altogether.

Bridging the gap between development finance and commercial finance are specialized private equity firms with emerging markets or renewables focus. The commercial bank sector has also made inroads in the less risky emerging markets, attracted by the guarantees of 15-20 year regulated returns most renewable energy projects warrant, and the opportunity to work with top utilities and developers.

Meanwhile, the largest clean energy markets can be attractive to international utilities as these are most likely to have well established renewables policies and the right wider power sector dynamics, and tend to see more equity investment. International utilities will typically partly fund projects through their balance sheets and secure debt at the corporate level or through dedicated funds with a more or less direct link to the project portfolio. Increasingly, utilities are seeking to tap the interest of institutional investors and other actors with a long-term, low-risk investment profile to sell on assets that have been commissioned while continuing to operate them (provided the market they are in appears stable enough to warrant this strategy).

Table 5: General emerging market foreign investment profiles by investor type and market risk

Investor group	Country risk / type of capital typically deployed (shade indicates exposure to the risk level)				
	Highest	High	Medium	Low	Lowest
Development and public finance	Debt	Debt	Debt	Debt	Debt
Private equity	Equity	Equity	Equity	Equity	Equity
Commercial finance	-	-	Debt	Debt	Debt
International utilities	Equity	Equity	Equity	Equity	Equity
Independent power producers	Equity	Equity	Equity	Equity	Equity
Renewables manufacturers	Equity	Equity	Equity	Equity	Equity
Large corporations	-	Equity	Equity	Equity	Equity
Non-profit	Grant	Grant	Grant	Debt	-

Source: Bloomberg New Energy Finance

Independent power producers have been active in similar markets since 2010, but have also played in some riskier countries where they have made use of finance provided by development banks to build projects. Renewable equipment makers and large corporates have tended to fund projects in the markets where their factories or other operations are, but the former are increasingly developing their activities as project developers to secure supply contracts for their products in new markets.

Disappointing "North-South" flows

"North-south" finance flows (from OECD[18] to non-OECD countries) are of particular interest in the context of the United Nations Framework Convention on Climate Change and the Paris Agreement. First at Copenhagen in 2009 then again at Paris in 2015, the world's most developed nations pledged to mobilize $100 billion annually starting in 2020 from public and private sources toward addressing climate change in emerging markets (details of the agreement here).

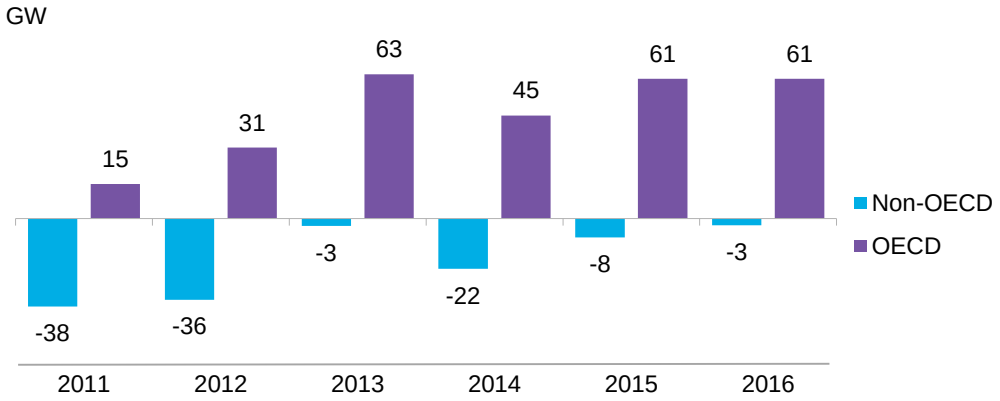
[18] The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental economic organisation bringing together 35 predominantly high income countries. Together, they account for 70 percent of the global economic output and the majority of international aid flows.

Decarbonizing power is by no means the only intended goal of the $100 billion, but the sector represents around a third of greenhouse gas emissions in emerging markets. Power sector CO2 emissions also grew by 65% from 2002 to 2012.

Supporting renewables deployment in emerging markets is all the more crucial as these countries are expected to account for the vast majority of future electricity demand growth due to the energy –intensive nature of their economies. Wealthy nations have demonstrated that they can grow their economies while keeping electricity demand flat, due to efficiency improvements. Not so in less mature economies with higher growth. Actions by regulators, investors, and developers taken today will impact those countries' CO2 emissions trajectories for decades to come.

Since 2010, fossil fuel capacity additions have consistently topped clean energy adds in emerging markets though the gap has generally been shrinking (Figure 52). Meanwhile, developed economies have added more non-emitting generating capacity than fossil capacity every year over that period.

Figure 52: Net new carbon-neutral power generating capacity additions



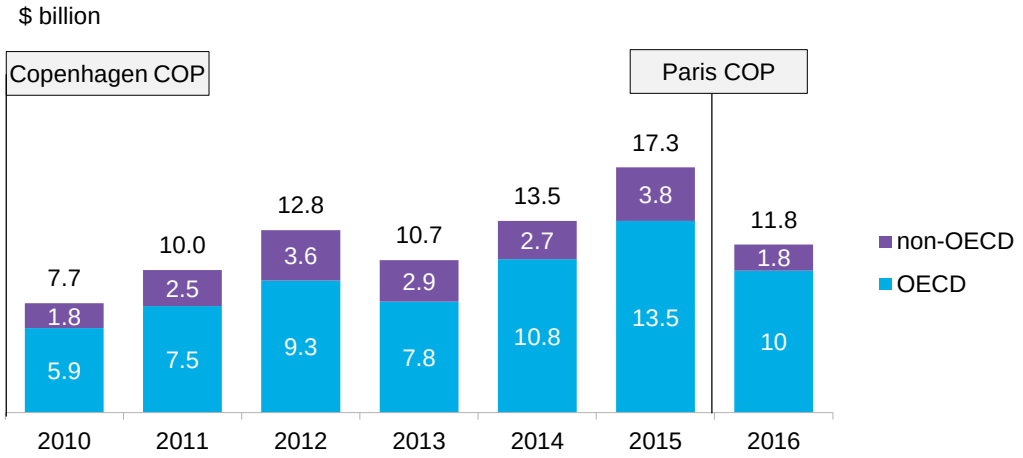
Source: Bloomberg New Energy Finance. Note: carbon neutral generation includes renewables plus large hydro and nuclear generation capacity.

Successes in some larger, developing countries to date prove that clean energy can be deployed at scale and at some of the lowest costs in the world, thanks in part to a firmly established global supply chain. But the capital generally only flows to countries that instill investor confidence by establishing clear, transparent, and sturdy policy frameworks.

The most developed countries (referred hereafter as OECD countries) accounted for the majority of international fund flows into clean energy asset finance in emerging markets (Figure 53). However, after growing almost every year and from $2.7 billion in 2007 to $13.5 billion in 2015, OECD country funding of clean energy projects in emerging markets suffered its largest year-on-year decline to $10 billion in 2016. Perhaps ironically, the drop came one year after the signature Paris Agreement under which wealthier nations affirmed an earlier commitment to provide financial assistance to the less developed to address climate change.

This 25 percent drop is deeper than the 18 percent fall for all clean energy investment recorded globally. In both cases, the declines are partly explained by falling per-unit costs for renewables (lower priced PV modules and wind turbines, primarily). But the vast majority of developing countries have not scaled clean energy deployment sufficiently to enjoy the full benefits of these lower costs. Moreover, with their incomplete or inadequate power grids and with millions of their citizens lacking complete energy access, their need for new generating capacity remains acute.

Figure 53: Clean energy financing for projects in developing countries, by source



Source: Bloomberg New Energy Finance. Note: OECD includes all OECD members including Chile, Turkey and Mexico which also belong to the "emerging markets" in other charts.

In the rest of this note, we explore the countries and actors that have been most successful in mobilizing international investment to date for clean energy projects in search of lessons to learn.

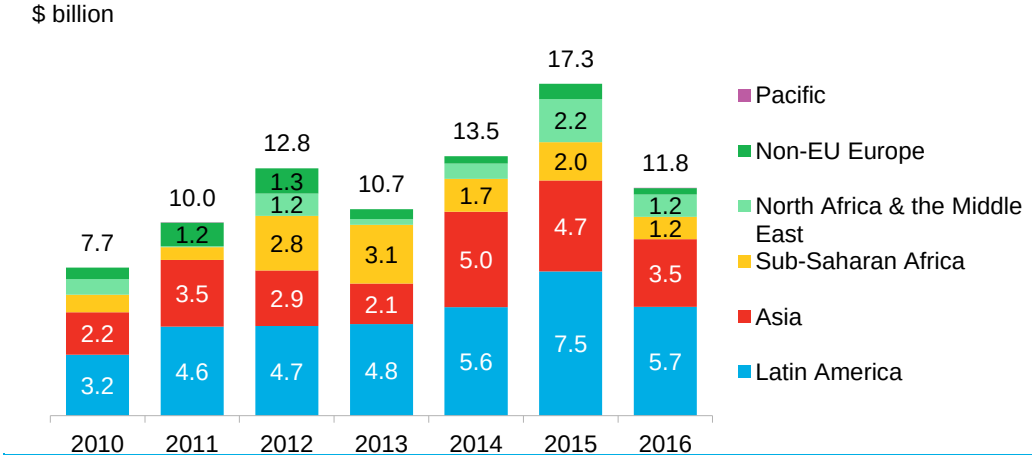
4.2. Destination of funds

The 106 developing nations reviewed for this survey represent extreme diversity and each offers its own unique set of investment conditions. Nonetheless, we can discern a number of clear regional, investment and policy trends. Latin America in particular is home to a group of countries that have successfully attracted large volumes of private clean energy investment thanks partly to similar approaches to policy-making.

Regional highlights

Latin America as a region has attracted the largest and steadiest flow of clean energy investment from overseas funders (Figure 54).

Figure 54: Foreign clean energy project capital deployed, by destination



Source: Bloomberg New Energy Finance. Note: includes only asset (project) financings

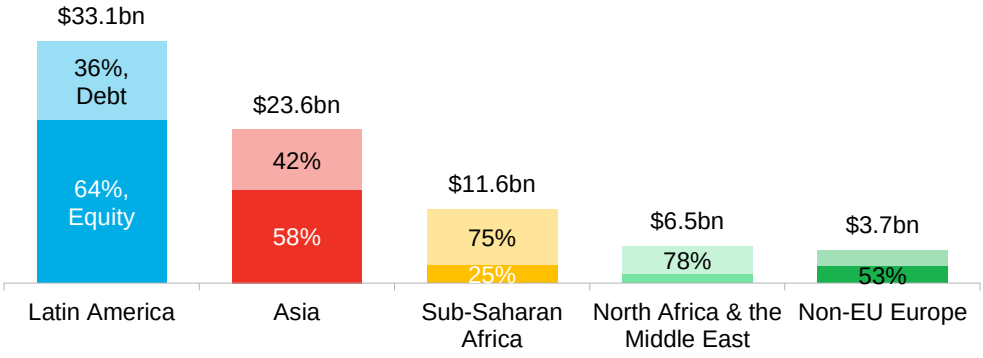
The region has recorded in excess of $3 billion every year since 2010. Half of the 21 countries with clean energy investment in Latin America attracted foreign investment in at least seven of the last ten years, accounting for 95 percent of the $43.4 billion of international finance flowing into the region over the period.

The volume of foreign capital attracted is particularly impressive given that the region has one seventh the population of Asia. Latin America also attracted particularly high levels of equity investment (Figure 55), indicating that the market conditions in the region encouraged international players to commit more capital than in any other.

Latin America has been a trailblazer in the design and implementation of tenders to award clean energy delivery contracts to renewable project developers. The majority of markets which have recorded clean energy investment in the region have held competitive auctions, either technology neutral or for renewables only, which have awarded winning developers with long-term revenue certainty. These auctions have also allowed produced some of the most competitively priced clean energy seen globally. They have also tended to co-exist with wholesale power markets used to organize dispatch and procure the remaining power on a merchant basis.

The region's strong overall performance does hide significant varied activity levels among countries, however. In Brazil, Chile, Honduras, Uruguay and Peru clean energy investment slowed in 2016 from 2015 levels. However, other countries have more recently picked up the baton, most notably Mexico.

Figure 55: International clean energy asset finance by region



Source: Bloomberg New Energy Finance

Asia has attracted the second highest volume of international clean energy capital with a slightly lower equity-to-debt ration than Latin America (Figure 54). Its largest markets of China, India, Indonesia, Pakistan, the Philippines and Thailand accounted for 91 percent of such international investment into the region. While clean energy auctions are gaining traction in Asia, investors there still face less homogeneous policy conditions there than in Latin America. Foreign investors also often face stiff competition from domestic players who can provide low-priced capital. This can include the China Development Bank, State Bank of India and Vietnam Bank for Agriculture, Rural Development and Thailand's Kasikornbank.

Most of **Sub-Saharan Africa's** asset finance from overseas financiers has been directed at South Africa, the region's largest economy. However, Ethiopia, Kenya and most recently Senegal all have begun to attract substantial sums for large onshore wind projects, despite challenging

development conditions. Solar investments, which tend to be smaller with an average size of 30MW, are also finally spreading to the region. Investment flowed to more than 200MW of new PV projects in the region outside of South Africa in 2015 and 2016, suggesting the continent is starting to seize the opportunity presented by cheaper solar.

The international investor group active in Sub-Saharan Africa remains dominated by development banks and private equity firms willing to assume greater risks because of mandates or the pursuit of high returns. The result is that international investment in the region has come predominantly in the form of debt which accounts for 80% of the total outside of South Africa.

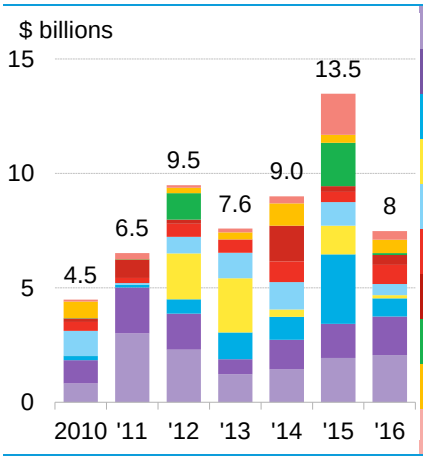
The Middle-East North Africa (MENA) region has seen investment concentrated on Egypt, Morocco, Jordan and Oman. The recent re-opening of Iran to international investment and the high potential for renewables in the country have also led to two first foreign investments from German firms for a combined $43 million. Both Morocco and Egypt have recorded investment in larger projects (each bigger than 180MW) requiring significant debt and bringing together a diverse group of public and private investors. Jordan's recent renewable energy boom is built on a vibrant solar sector which attracted $1.4 billion in international investment.

Non-EU Europe investment activity has been slow. Turkey is the largest renewables market in the region with $12.6 billion of investment recorded between 2010 and 2016, a quarter of which was financed by international players. Investment in the rest of the region, notably in Russia, remains stubbornly low.

Country highlights

In line with regional trends, **Brazil**, **Chile** and **Mexico** are among the countries that have attracted the most foreign investment from overseas financiers since 2010 (Table 6).

Table 6: Top destination countries for foreign investment in clean energy asset finance



		Share of country total	Debt: Equity ratio	Share by investor type			
				Development bank	Utility	Private equity	Project developer
Brazil	$12.78bn	30%	10-90	5%	49%	9%	14%
India	$9.73bn	18%	31-69	24%	13%	23%	23%
Chile	$6.92bn	75%	38-62	18%	46%	6%	6%
South Africa	$6.10bn	39%	68-32	32%	13%	7%	7%
Mexico	$5.72bn	56%	35-65	16%	44%	7%	7%
China	$3.94bn	1%	30-70	27%	9%	9%	9%
Indonesia	$3.39bn	66%	77-23	58%	5%	4%	3%
Morocco	$3.17bn	70%	83-17	77%	7%	5%	5%
Kenya	$3.16bn	79%	87-13	76%	2%	3%	3%
Pakistan	$3.10bn	76%	47-53	31%	11%	25%	25%

Source: Bloomberg New Energy Finance

They differentiate themselves from the rest of the top ten in having attracting significant levels of equity investment from utilities such as Italy's Enel ($6.16 billion), China's State Grid Corporation ($1.63 billion) and France's Engie ($1.06 billion). The commitment of equity capital from large international energy companies in these countries highlights their success in establishing the

successful regulatory frameworks. Brazil and Chile have used auctions to award developers of clean energy projects long-term price guarantees since 2006. This has allowed Brazil to procure large amounts of onshore wind capacity at extremely competitive prices, with clearing prices in the $50-60 per MWh range as early as 2009-2010. Chile's technology-neutral auctions for years failed to support investment in renewables as the technologies struggled to compete with fossil fuels on price, but the tide turned in 2014 after solar and wind costs fell. Mexico has been home to a vibrant business-to-business power purchase agreement (PPA) market that supported activity there until power sector reforms took hold in 2016 with state-sponsored contract reverse auctions. These awarded 5.5GW of renewables long-term contracts at record prices in 2016 alone, taking investment to new heights with $3.68 billion committed in 1H 2017.

With the launch of the ambitious renewables targets and auctions, **India** has more in common features with Latin American markets and has sought to jump-start activity accordingly. However, a focus on solar in India rather than wind to date has lured a broader group of investors into the market. Private equity and project developers account for almost half of the foreign investment in India. France's Engie has been among the main international utilities to enter, but it has sought to reduce exposure in India in 2016-17 in light of the extreme competition of local players.

South Africa also attracted record levels of investment through its auctions and the support granted to an expensive solar thermal project which alone accounted for a third of all clean energy investment in the country. Investment from overseas into South Africa has been dominated by a mix of equity and debt provision of Old Mutual PLC, the life insurance company that originated in South Africa and is now headquartered in the United Kingdom. The comparatively high level of debt financing in the country is explained by the high cost of solar thermal project and expectations that the Rand will appreciate.

China offers different incentives for international investors who collectively represent a meager 1% of the country's clean energy asset finance. The majority of the funds are linked to companies that are seeking to establish themselves in the Chinese market and build partnership with local players. For example, Canadian Solar is counted as the largest foreign investor in clean energy assets in China. However, despite being registered in Canada, the company has longstanding deep ties to China and today is one of the largest PV module manufacturers in the country. Other global companies that have increased their exposure or bettered their image in China through clean energy investments include Apple, EDF, Total or Siemens.

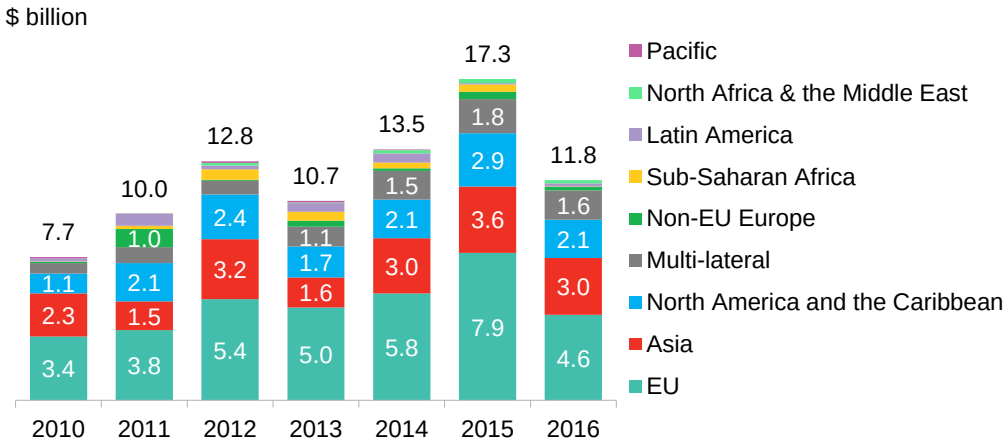
Indonesia, **Morocco** and **Kenya** secured between 58-76% of international investment from developing banks, mostly in the form of debt. The high debt levels highlights the role development banks can play in providing long-term financing to very large infrastructure projects in emerging markets. They plaid a critical part in financing the $1.04 billion solar thermal NOOR project in Morocco, and billion dollar geothermal projects in Kenya and Indonesia.

Pakistan has benefited from China's ambition to become one of the largest infrastructure investors across the developing world with around two thirds of its clean energy funding coming from the country. This is a result of the "China-Pakistan Economic Corridor", a bilateral program with a budget of $62 billion for infrastructure investment in Pakistan as of April 2017. In the renewables sector, private consortia bringing together Chinese and Pakistani firms have access to concessionary finance at rates as low as 5-6% – far below the rates charged by commercial banks in the country, and lower than most existing development loans.

4.3. Origin of funds

The origin of international clean energy asset finance flows into emerging markets is highly diverse. BNEF tracked investments originating from 77 countries into the 106 markets surveyed in this analysis, linking back to where the organization's corporate or other parent is domiciled. The European Union collectively represents the largest foreign source of investment into emerging markets clean energy projects, accounting for just over 40% of the flows recorded 2010-2016 (Figure 56). This outweighs its share of global GDP which stood at 22.8% in 2016, according to the International Monetary Fund. By comparison, the U.S. accounted for 10% of international investments into renewables in emerging markets but represented 24.7% of world GDP. Asia is the second largest originator of investments led by the China-Japan duo ($5 billion each) and the Singapore and Hong Kong financial centers.

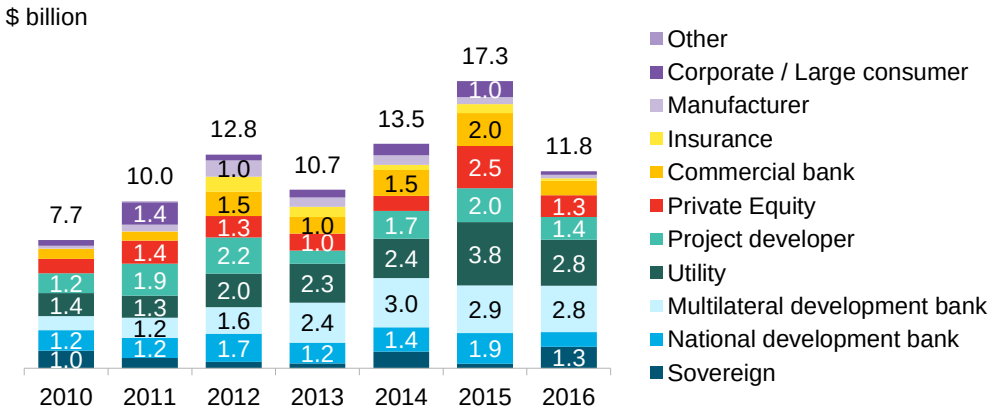
Figure 56: International clean energy asset finance in emerging markets by origin



Source: Bloomberg New Energy Finance

Private sources of money accounted for twice as much non-domestic clean energy asset finance in emerging markets as public sources (Figure 57), led by high contributions from utilities and project developers (19% and 17% of investment respectively 2010-2016).Private equity firms are the largest source of capital from the non-concessionary finance community as they tend to have a higher risk appetite and be more specialized than commercial banks and insurance firms. Investment from renewable energy equipment makers and large non-energy sector companies was patchier over the period, accounting for 10%.

Figure 57: International clean energy asset finance in emerging markets by investor type



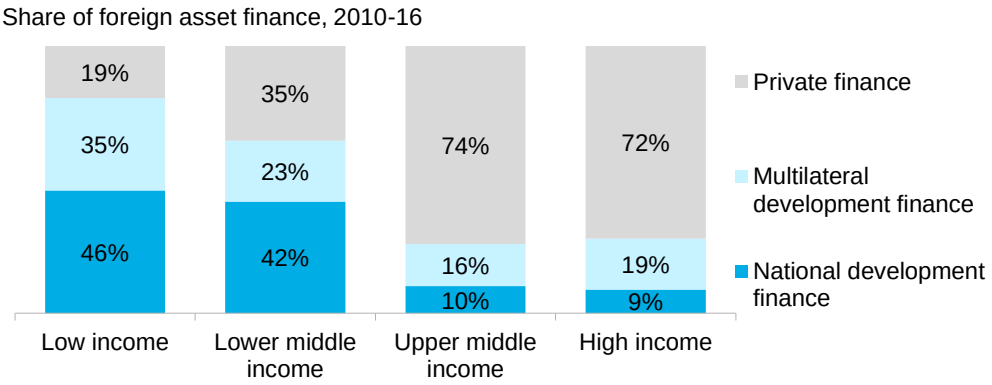
Source: Bloomberg New Energy Finance

Funding from all public sources jointly account for 34% of international clean energy investment in emerging markets and has been the most stable source of finance alongside utilities. However, national development bank activity specifically has been more variable and dropped to a recent low of $870 million in 2016. The fall was caused by a sharp drop in funding from Germany's development bank and the European Investment Bank. These were only partly compensated by rising funding from national development banks in France, Denmark and the Netherlands.

Development finance

Development finance plays an important role in the funding of clean energy assets in developing countries and accounted for around a third of all international flows from 2010-2016. The goal of development finance is to deliver capital where commercial banks and others will not venture. Development institutions today are by far the largest providers of finance to clean energy projects in the world's least developed economies (Figure 57 and Figure 58).

Figure 58: International sources of developing country clean energy asset finance by country classification

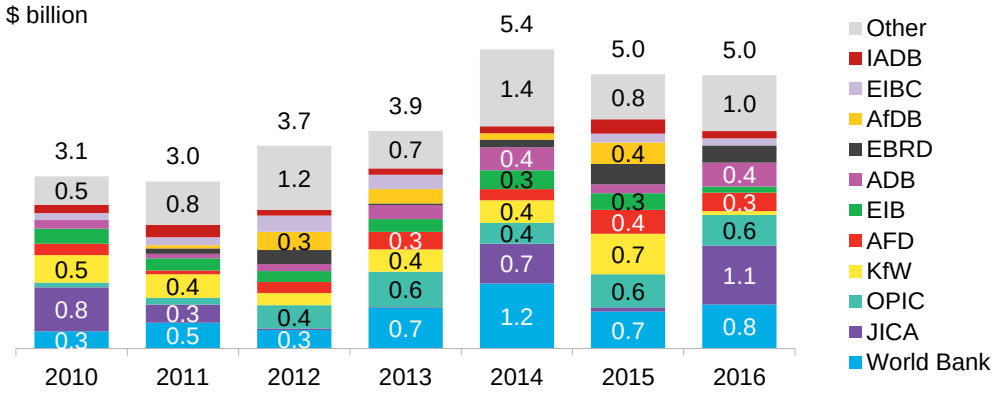


Source: Bloomberg New Energy Finance. Note: income group classification from World Bank.

However, it is important to note that the very diverse group of development finance institutions (62 tracked in this analysis, Figure 59) offer investment under different conditionality and terms of reference, and that their prime purpose is to offer debt, not equity capital, in markets where it is

either too costly or entirely unavailable. National development banks will also often support projects that involve companies of their country or align with its diplomatic priorities.

Figure 59: Development bank clean energy asset finance in developing countries

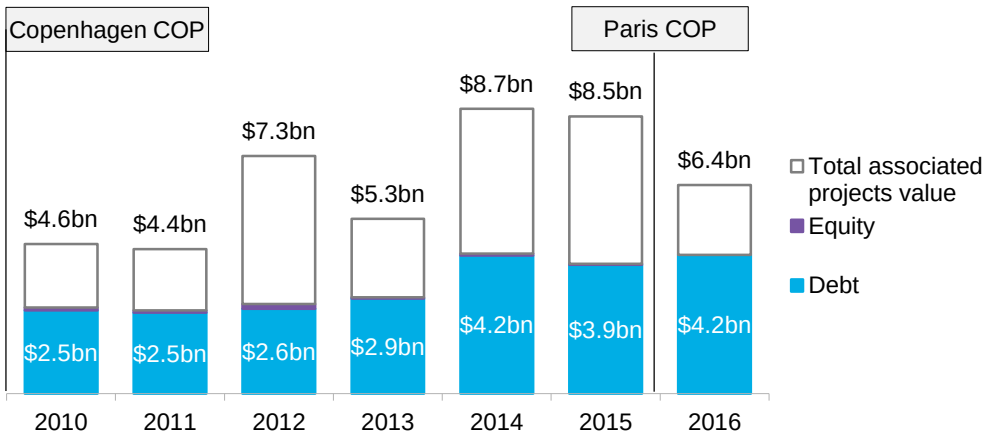


Source: Bloomberg New Energy Finance. Notes: JICA – Japan; OPIC - U.S.; KfW – Germany; AFD – France; EIB – EU; ADB – Asia; EBRD, IADB - multi-regional; AfDB – Africa; EIBC - China

This has important implications in the context of global climate negotiations and the pledge of OECD countries to mobilize $100 billion annually to address climate change in developing nations by 2020. Since this pledge was first made at Copenhagen in 2010, the rate of growth of development finance flowing to clean energy projects in developing countries has risen but not spectacularly (Figure 60).

Figure 60: OECD sovereign and development funding of clean energy projects in developing countries and associated leverage effect

OECD public and development funding to clean energy asset finance in emerging markets



Source: Bloomberg New Energy Finance

An important ambition of the Copenhagen pledge was the public funds deployed would be able to leverage much larger volumes of capital from private investors. At least as far as clean energy is concerned, however, there is little hard evidence to suggest this is working.

The average leverage value achieved by OECD-originated development finance for 2010-2016 has been 2.65. In other words, the provision of one dollar of concessionary debt in developing

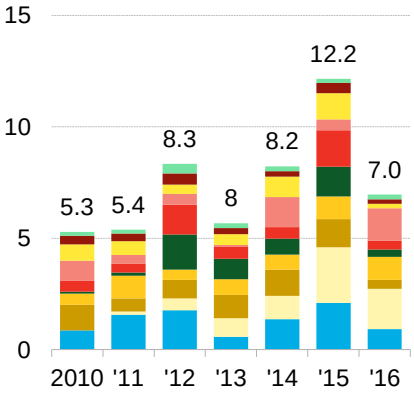
countries has resulted in the investment of $2.65 into clean energy projects on average for the period. For comparison, concessionary debt plans run by the European Investment Bank for projects in the EU target a 15-to-1 leverage ratio.

This suggests that for clean energy to contribute its share toward the $100 billion Copenhagen/Paris goal, far more development finance will likely be needed than has been delivered to date. It suggests also that OECD countries will struggle to achieve similar leverage effects to those delivered by policy banks in their home markets. Turning the issue around, the low levels of leverage achieved could also, at least in part, be a result of the little effort made in disbursing funds to quality projects that would deliver higher levels of leverage. Pressure on development institutions to meet their disbursement targets or cooperation objectives may well result in investment going through without enough emphasis on building the right framework conditions to reduce the cost of the investment. This could make a huge difference in clean energy projects which typically have high upfront costs and rely heavily on long-term funding.

Top emitting countries

Private equity companies and project developers account for the bulk of **U.S.** investment into emerging markets (Table 7). Including manufacturers-turned-developers such as SunEdison covers 71% of total investment from the U.S. This group of often specialized players has shown a willingness to commit high levels of equity capital across emerging markets provided a bankable PPA is at hand. These conditions were often met in India and Latin America, and a selection of other Asian markets from 2010-2016. As a result, private investors from the U.S. provided more equity capital to projects in emerging markets than investors from any other country.

Table 7: Largest origin country for foreign investment in clean energy asset finance in emerging markets



		As share of country 2016 GDP	Equity to debt ratio	Share by investor type			
				Sovereign	Utilities	Project developers	Private equity
U.S.	$8.03bn	0.43‰	86-14	9%	3%	16%	38%
Italy	$6.79bn	3.67‰	99-1	<1%	99%	<1%	<1%
Spain	$6.08bn	4.94‰	80-20	1%	46%	19%	2%
France	$5.23bn	2.12‰	57-43	32%	33%	19%	3%
U.K.	$5.13bn	1.96‰	46-54	<1%*	<1%	18%	23%
China	$5.04bn	0.45‰	67-33	19%	41%	18%	<1%
Japan	$5.02bn	1.02‰	12-88	60%	2%	4%	<1%
Germany	$3.83bn	1.11‰	25-75	64%	2%	4%	3%
Singapore	$2.36bn	7.95‰	99-1	<1%	<1%	58%	30%
Netherlands	$1.53bn	1.99‰	25-75	50%	3%	3%	13%

Source: Bloomberg New Energy Finance. Note: the U.K. development institution, CDC Group, focus its finance activity on investing in funds managed by other organizations, hence the capital it has deployed does not appear here to avoid double counting. Over the 2010-2016 period, the CDC group deployed around $650 million into clean energy focused investments in Asia and Africa.

Italy's placement at second in the top 10 is nearly entirely due to Enel. The country's utility giant accounted for more than 98% of clean energy asset finance flowing from the country to

developing nations from 2010-2016. The company has been highly aggressive in winning long-term contracts in clean energy auctions, having built on its early mover experience acquired in Latin America where the majority of its foreign investments are located. Enel has used its balance sheet and access to cheap finance at the corporate level to fuel expansion into emerging markets. Utilities are also the main driver of foreign investment from **Spain**, accounting for 46% of the country's total with a similar focus on Latin America. They are followed a strong group of commercial banks led by Banco Santander which accounted for around a quarter of the funds flowing out of the country.

Funds from **France** have primarily flowed from its two large utilities, EDF and Engie, which have deployed equity capital much in the same fashion as their Italian and Spanish peers, and the country's development bank, the Agence Française de Développement, which specializes in providing debt to developers. Together, they accounted for two thirds of the funds that flowed out of the country. Crédit Agricole and Société Génerale, two of the country's largest commercial banks, have also gained emerging markets exposure with lending in Latin America and Indonesia.

U.K. investors into emerging market asset finance are led by the finance industry which accounted for three quarters of total investment over 2010-2016. Old Mutual PLC, the South Africa-born but U.K.-headquartered insurance company alone accounted for around half of the amount, the majority of which was deployed to projects involved in South Africa's auctions. However, the company also ventured into Kenya where it provided debt to the Lake Turkana and Kipeto onshore wind projects. Leading emerging market private equity firm Actis is the second largest investor, accounting for 20% of the U.K. total, mostly deployed in equity investments across Latin America. Standard Chartered and HSBC complete the finance industry top four with investments in their "second home" market of Asia, and some exposure to Latin America for HSBC. Oil major BP accounts for the majority of the rest of the financial flows with biofuel investments in Brazil.

China's emerging market investment activity has shown more variability than headlines on the country's ambitious new "One Belt One Road" strategy might suggest. China deployed a record of $1.59 billion into other nations in 2015, only to drop back to $401 million in 2016 with no signs of acceleration in early 2017. Leading the movement are the country's four main utilities, the State Grid Corporation in particular, which accounted for around 35% of the total alone. Chinese projects developers are also going abroad to seize opportunities away from their extremely competitive domestic market. The commercial bank sector has also started to venture out of its home market into the rest of Asia.

Japan and **Germany** have shown a similar foreign investment pattern, dominated by the provision of debt by their respective development banks. Japan's JICA has been more heavily invested in Asia and Latin America, while Germany's KfW has focused on MENA. This partly reflects the respective diplomatic and cultural priorities of the countries. Japan's commercial banks have also shown a strong appetite for emerging markets lending with $1.8 billion of finance delivered primarily in Asia and Latin America. The rest of German investment is relatively evenly distributed across the commercial bank, large corporation and manufacturer categories.

Singapore, thanks to its supportive tax environment and geographic location, is home to a large community of project developers and private equity firms active in the region, led by Orient Green Power and Equis respectively. All of Singapore's foreign investment has been deployed within the region.

Half of the **Netherlands'** contribution to international investment into emerging markets renewables project can be linked back to the country's development bank, the FMO, which is

granting funds, mostly as loans, throughout the developing world. Rabobank, the second largest commercial bank in the country, has also deployed significant capital in Latin America and Asia.

The final section of this analysis presents the top providers of foreign investment into clean energy projects in emerging markets. The analysis is based on over 2300 deals BNEF tracked in across 106 emerging markets for a combined value of $162 billion.

4.4. Top international investors - overview

DEVELOPMENT BANKS

Development banks provided the amount of international finance for clean energy projects in emerging markets, with 35% of total over the 2010-2016 period. Multi-lateral development banks account for just under half of all the loans for the period while the rest was provided by national banks whose mandate is often to support the diplomacy or businesses of their country. The evolution of funds coming from China's policy banks shows no sign of particular acceleration in the clean energy space with annual investments averaging at $180 million a year over the period. The geographical distribution does, however, confirm China's focus on the Pakistan economic corridor project and on natural resource rich countries across Sub-Saharan Africa.

Lending, 2010-16		Leverage achieved	Geography	Risk	Technology
World Bank	$4.33bn	x3.74			
JICA	$3.00bn	x1.82			
OPIC	$2.80bn	x1.66			
KfW	$2.77bn	x3.56			
AFD	$1.76bn	x5.95			
EIB	$1.65bn	x6.09			
ADB	$1.63bn	x2.74			
EBRD	$1.21bn	x2.36			
AfDB	$1.15bn	x6.09			
EIBC	$1.12bn	x1.75			

INTERNATIONAL UTILITIES

Utilities account for 20% of the international finance deployed to clean energy projects in emerging markets over the 2010-2016 period. This group includes Italy's Enel, the largest single foreign clean energy investor in emerging markets today. This highlights the contribution of European utilities in general, as they represented 73% of the investment from this group. Chinese utilities accounted for 13% of the total, led by the over $1.6 billion of small hydro investment by the State Grid Corporation in Brazil. A number of utilities have made investment in markets where they are exposed to curtailment due to oversupply or the lack of grid.

Investment, 2010-16		-in markets with risk of curtailment	Geography	Risk	Technology
Enel	$6.70bn	32%			
SGCC	$1.63bn	-			
Engie	$1.21bn	17%			
Acciona	$1.09bn	37%			
CLP	$0.99bn	100%			
Abengoa	$0.54bn	32%			
EDF	$0.48bn	88%			
Iberdrola	$0.43bn	-			
EDP	$0.39bn	-			
Gas Natural	$0.34bn	-			

KEY:
Geography - Asia | SSA | LAC | MENA | Europe
Risk - Lowest | Highest
Technology - Solar | Wind | Geothermal | Small Hydro | Biomass | Biofuels

Source: Bloomberg New Energy Finance, OECD Note: OECD risk premium used for risk exposure analysis.

PROJECT DEVELOPERS

The project developer group accounts for 12% of all the foreign clean energy asset finance in emerging markets tracked in the analysis. It accounts for the largest group of organization with over 541 individual companies involved in clean energy projects in the developing world. Latin America markets using auctions, and India account for the lion's share of their investment.

Investment, 2010-16		-in markets with risk of curtailment	Geography	Risk	Technology
Voltalia	$671m	-			
Orient Green Power	$650m	100%			
Zonergy	$648m	100%			
BP	$507m	1%			
ContourGlobal	$453m	-			
Sembcorp	$433m	100%			
SkyPower	$350m	100%			
ACS	$311m	-			
Akuo Energy	$292m	-			
Solarpack	$275m	69%			

PRIVATE EQUITY, COMMERCIAL BANKS & INSURANCES

Private investors accounted for just over a fifth (23%) of all the foreign investment into clean energy project in emerging markets. The top 10 includes organizations includes commercial banks, private equity fund and even one insurance. This highlights that private financiers with a variety of risk-revenue profiles have caught on to the attractiveness of renewable energy projects which offer exposure to regulated returns thanks to the tariff they are award, and to the opportunity of increasing exposure to growth markets which have predominantly been in the developing world in recent years. The leverage achieved by the top ten private investors is higher on average than the one achieve by development banks.

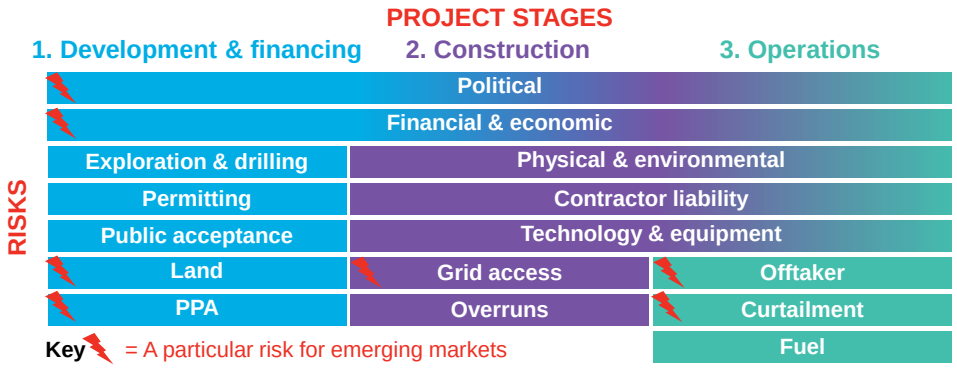
Investment, 2010-16		Leverage achieved	Geography	Risk	Technology
Old Mutual	$2.31bn	x4.60			
Actis	$1.10bn	x2.35			
Santander	$1.03bn	x4.28			
Sumitomo	$0.84bn	x6.00			
Equis	$0.65bn	x1.63			
BBVA	$0.48bn	x4.84			
HSBC	$0.43bn	x4.43			
Climate Inv. Fund	$0.35bn	x5.32			
DNB	$0.35bn	x4.43			
ICBC	$0.34bn	x2.63			

Source: Bloomberg New Energy Finance, OECD Note: OECD risk premium used for risk exposure analysis.

Section 5. How to Mitigate Renewables Risks in Emerging Markets

Every renewable energy project entails risk, but one in an emerging market can bring more and different types of risk. There is no one-size-fits-all solution, although there are many instruments available on the market – for a price. And sometimes a tool is not necessary. This commentary focuses on the higher and different risks faced when developing a renewables project in the 71 emerging markets covered by the 2017 *Global Climatescope* project (the red lightning bolts in Figure 61).

Figure 61: Renewable project risks

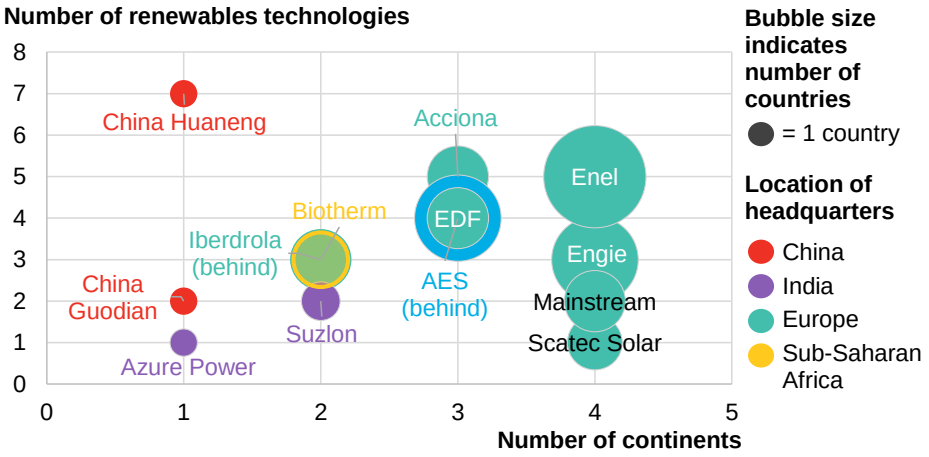


Source: Bloomberg New Energy Finance

- The use of political risk insurance and other types of guarantee has been limited for renewables. Reasons include high costs, complex application processes, preference for large projects, limited coverage, lack of awareness of the available tools, long processing times and stringent eligibility criteria.
- A sovereign guarantee might appear the Holy Grail for offtaker risk, but it is only as good as the government's balance sheet, as found in Tanzania. A developer may secure a partial risk guarantee, though only debt lenders will be covered and only if the offtaker is state-owned.
- Companies vary in their use of currency hedging instruments: Enel prefers forward contracts and Canadian Solar also uses the more flexible but also more expensive options. EDF keeps its foreign exchange positions open if no instruments are available, or if hedging costs are prohibitive, and instead it monitors the risk on such positions using sensitivity calculations.
- Risk mitigation does not always mean purchasing an instrument of some kind: for example, a favorably negotiated power-purchase agreement (PPA) can help manage the risk of currency fluctuation, interest rate increases and curtailment.
- A geographically diversified portfolio of projects may reduce a developer's political risk, while partnership with a local company and strategies to increase local buy-in may alleviate the risk of disputes over land ownership. Renewables developers vary in their geographic and technological diversification (Figure 62).

- Sometimes the risk mitigation is mostly out of the hands of the developer: the government can help manage currency fluctuation for developers by paying tariffs in U.S. dollars (eg, Chile) or using a fixed exchange rate (eg, Ghana, Jordan).

Figure 62: Renewables developers' technological and geographic diversification in emerging markets



Source: Bloomberg New Energy Finance. Note: Covers Climatescope countries only. Large and small hydro counts as one technology. Mainstream includes Lekela Power.

5.1. Political risk

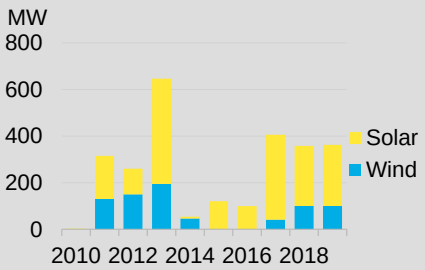
A renewables developer or investor in an emerging economy may face an increased risk that its returns or earnings could decline as a result of political changes, such as war and terrorism, expropriation, and sovereign breach of contract. Renewable energy projects are particularly exposed to the risk of a change in law or policy, given their current reliance on government subsidies. For example, in 2013, the Indonesian government introduced a solar auction program, aimed at developing the country's solar power capacity through regular tenders. A year after its introduction the program was ruled unconstitutional by the Supreme Court and closed, after the association of PV manufacturers sued the government for allowing foreign equipment to be used at all.

Political risk: Ukraine

Wind and solar capacity additions in Ukraine ground to a halt in 2014, with the 100-day revolution, Russia's annexation of Crimea and start of the war in Donbas.

Investors began to return to the market in 2016 when the economy stabilized and the government made some favorable changes to the green tariff.

Figure 63: Ukraine wind and solar additions



Source: Bloomberg New Energy Finance

The main strategy for mitigating political risk in the power sector is to buy some form of targeted insurance or guarantee. For example, the World Bank's Multilateral Investment Guarantee Agency (MIGA) supplied political risk insurance for the 47MW Rajamandala small hydro project in Indonesia. Instead, a renewables project may rely simply on a bilateral investment treaty between the project and developer's home countries. Where there is no such treaty, investors may sign host government agreements with stabilization clauses specifying that for the duration of the project, the relevant legislation will remain the same. Such clauses may also require the government indemnify investors of the cost of complying with any changes in law. One renewable energy example was in Ukraine with regard to the renewables feed-in tariff.

Such tools should enable developers to secure financing more easily or at least on better terms. In addition, some providers – particularly public ones – can influence the host government and help prevent adverse events or secure preferential treatment for investors. However, these mechanisms raise challenges:

- Coverage may be limited and contract language may be ambiguous.
- The insurance or guarantee provider may impose stringent social, economic and environmental criteria.
- Some tools are expensive and only cover a share of the investment.
- It can be time-consuming to secure an instrument or to structure an investment to benefit from a given treaty.
- With a bilateral investment treaty, winning an award against a country does not automatically mean payment.
- They have also been criticized for focusing on protecting foreign investors, without taking account of the national conditions.
- Historically there have been issues around the enforceability of stabilization clauses.

5.2. PPA

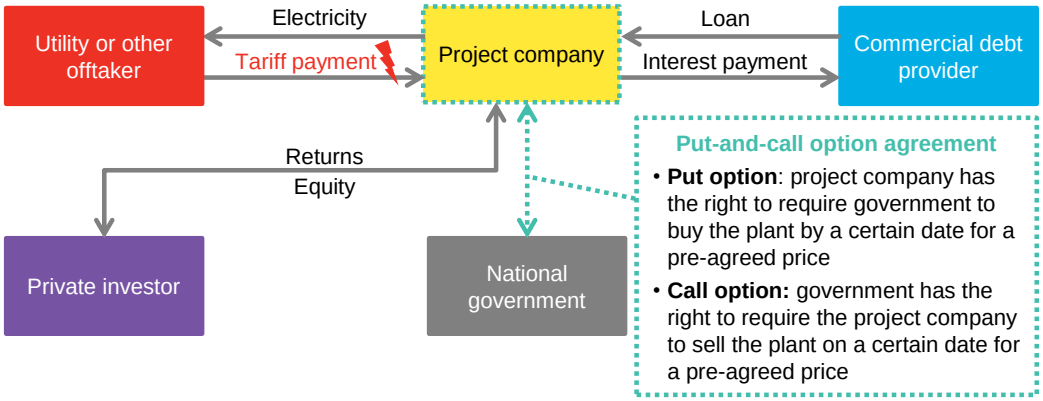
This risk arises when a developer encounters barriers to securing a PPA, or a deal may be reached but at a later date the government or utility wishes to renegotiate the terms (see box).

PPA risk: South Africa

Participants in South Africa's renewables auction program have faced considerable policy uncertainty in the last two years, after the offtaker, Eskom, refused to sign PPAs for 27 renewables projects that had won preferred bidder status in 2015. These deals were due to be signed by October 28, 2017 – but at lower tariffs – the former Energy Minister Mmamoloko Kubayi announced on September 1. This deadline has now been moved to November 20, according to media reports. This policy uncertainty has caused South Africa to drop one place in Climatescope 2017 to sixth position. Focusing only on its enabling framework, the country saw a 9% decrease in its score in 2017.

There are a few mechanisms to protect the developer against PPA risk, with one being a partial risk or credit guarantee (see below). However, such instruments bring the challenges outlined above, as well as only being applicable where the offtaker is state-owned. Another way to mitigate PPA risk is for a developer to sign a put-and-call option agreement with the government (Figure 64). In April 2017, the Nigerian government signed such deals with two local solar developers, which are planning to build two PV plants totaling 120MW. This West African nation has risen to 24th place in Climatescope 2017 from 30th in the 2016 edition.

Figure 64: Example structure of a put-and-call option agreement



Source: Bloomberg New Energy Finance

On the down side, such agreements can be expensive and some countries such as Russia do not recognize put or call options. In addition, the termination payments will depend on the reason why the PPA ended. In the case of Nigeria, the outstanding debt will be paid back in full but the equity investment may be recovered in full or impaired, depending on the case of the termination.

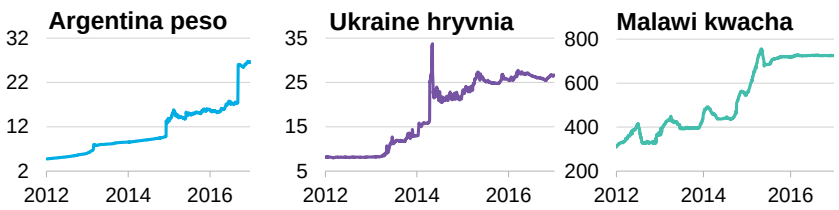
Offtaker risk: Argentina

When it launched its RenovAr renewables auction program a few years ago, investors were concerned about sovereign and offtaker risk. As a result, it created the national renewable energy trust fund 'Foder', which offers auction winners both a liquidity and termination guarantee, protecting the companies from offtaker, PPA, currency convertibility and certain political risks.

5.3. Currency fluctuation

Developing countries account for 46 of the 50 most volatile currencies over the last five years (Figure 65). Currency fluctuation or devaluation risk for a renewables project arises from the mismatch between the currency of payment in the PPA and that of obligations for operating expenses, taxes, loan repayments on the one hand, and dividend payments and profit repatriation on the other. Developers and investors will therefore try to mitigate the risk or price it into their tariffs. Problems can also arise if the PPA tariff uses a fixed exchange rate (see box).

Figure 65: Top three most volatile currencies relative to the U.S. dollar in the last five years

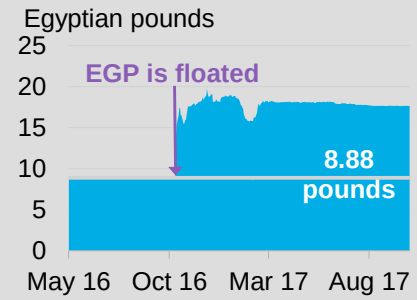


Source: Bloomberg

Currency fluctuation risk: Egypt

The Egyptian pound has halved relative to the U.S. dollar since currency controls were scrapped in November 2016 (Figure 66). Feed-in tariff participants are partially shielded from the currency risk as the majority of the dollar-denominated tariff is paid (in pounds) at the prevailing exchange rate. However, another part (30% for PV, 40% for wind) is paid at a fixed exchange rate. This fixed rate, of 8.88 pounds per dollar is far from the current rate, which has stabilized at around 17-18 pounds since March.

Figure 66: USD: EGP exchange rate



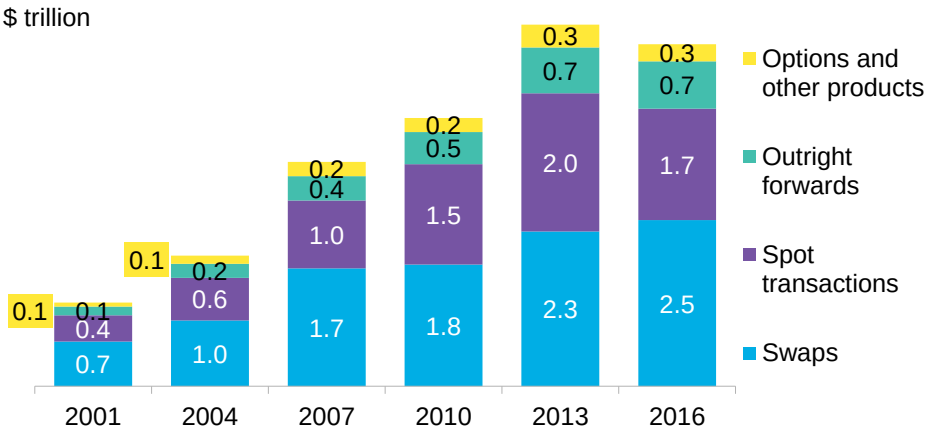
Source: Bloomberg

One of the main areas of exposure to currency risk relates to the source of financing. Developers can therefore help mitigate these risks by:

- Obtaining debt financing in local currency and using domestic equipment.
- Taking on a loan denominated in local currency from a lender based outside the host country.
- Securing a local-currency loan and hedging the risk by using an international hedge provider such as the TCX Currency Fund.
- Using a back-to-back structure where the developer borrows from an outside lender in the form of dollar-denominated loan and uses the dollar proceeds of the loan as collateral to obtain a local-currency-denominated loan from a local bank.

A developer may purchase a sometimes expensive risk-hedging instrument such as a currency swap (Figure 67). Forward/futures contracts are easier to manage and have a lower upfront cost but locking in a fixed forward price can be expensive if the currency moves against the contract holder. Options offer more flexibility, although premiums can be high.

Figure 67: Global over-the-counter foreign exchange turnover



Source: Bank for International Settlements. Note: Adjusted for local and cross-border interdealer double-counting (ie, 'net-net' basis).

5.4. Currency convertibility and transfer

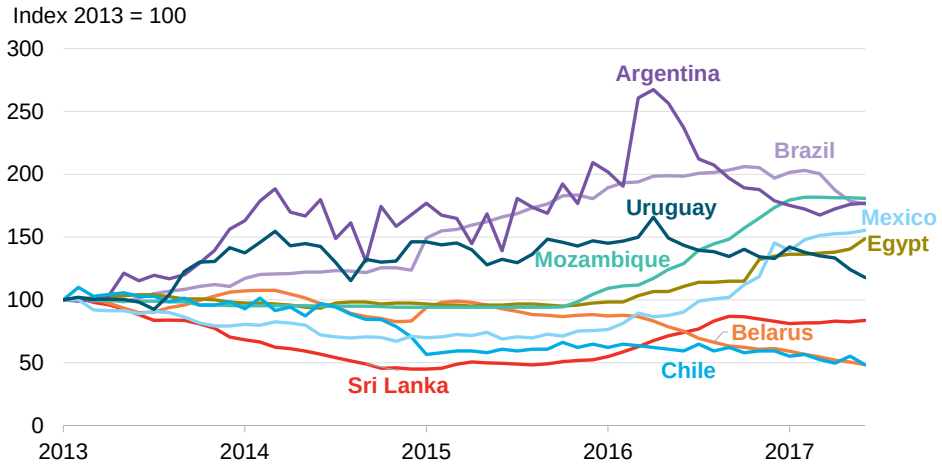
This risk arises when government capital and exchange controls prevent or impede the ability to convert local into foreign (hard) currency or transfer funds outside the country. As in many of the former Soviet republics, foreign companies in Tajikistan have faced considerable issues with currency convertibility and transfer. In April, the central bank implemented measures to stabilize the somoni, after it has lost 7.3% against the dollar since the start of the year. A shortage of U.S. dollars in circulation was one of the main drivers behind the drop.

The most common tools used to mitigate convertibility risk and transfer restrictions are political risk insurance or guarantees such as those offered by MIGA, and the African and Asian Development Banks. In addition, developers would need to allow additional time in their planning in order to transfer money out of the country.

5.5. Interest rate risk

As with currencies, emerging markets can also have volatile interest rates. Compare Figure 68 with trends in developed countries: interest rates in the U.S. have varied by 0.75 percentage points over the same period and those in Canada by 0.3 percentage points. They did not change in the U.K. – although they did finally rise slightly on November 2, 2017.

Figure 68: Index of interest rate movements in selected emerging markets



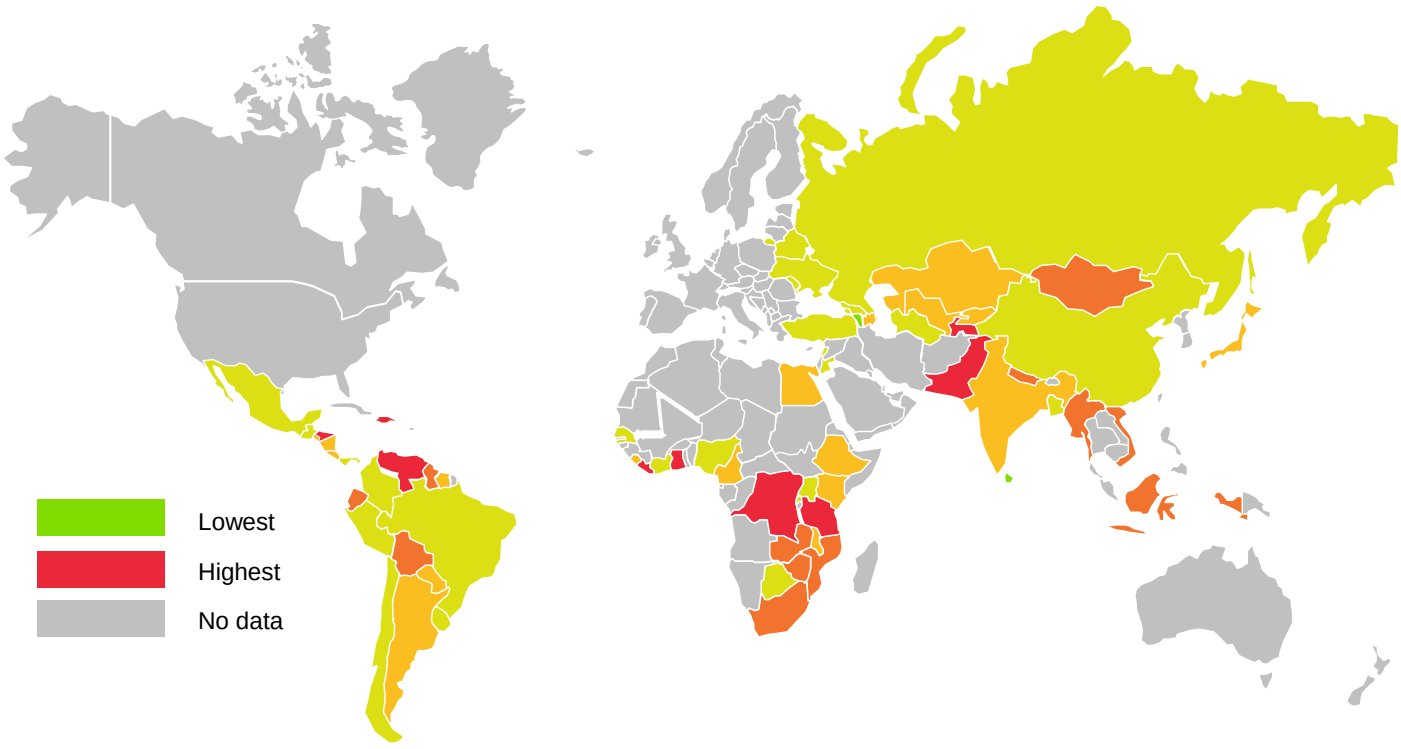
Source: International Monetary Fund, Bloomberg New Energy Finance

A variable interest rate exposes investors to interest rate risk, increasing debt costs. A fixed rate is not perfect either, as the forward rate may end up above the actual rate in the future. Like most developers, Norway's Scatec Solar has a mix of both, and for its floating-rate debt, it has undertaken fixed-rate interest swaps "for a major portion of the portfolio", according to its 2016 annual report. Some developers vary by currency: Azure Power India has a floating rate for its rupee-denominated debt and fixed for U.S. dollar borrowings.

5.6. Offtaker

Offtaker risk – ie, the possibility that the electricity utility fails to pay on time or in full – was assessed as part of the Climatescope project, taking into account the company's financial history, sovereign guarantees and perception among players in the market. The developing countries covered by the project average at 'somewhat high risk'. Only the Public Utilities Commission of Sri Lanka and Electric Networks of Armenia secured the top rating of 'very low risk', and 10 countries fell at the other end of the range. Of the laggards, Tanesco in Tanzania was rated 'very high risk' due to its continued non-payment of generators, prompting Symbion, one of the IPPs, to sue the utility for $561 million. The continued high offtaker risk in the East African country has helped to reduce its score by 15% in Climatescope 2017 to 1.30, pulling it down 10 places to 29th.

Figure 69: Offtaker risk in emerging markets based on Climatescope project results



Source: Bloomberg New Energy Finance. Note: A lower score indicates a higher-risk market.

One option is to secure a sovereign guarantee from the host country government but these are only as robust as the government's balance sheet – as IPPs have found in Tanzania. For that reason, governments are increasingly reluctant to issue them (especially for smaller projects) and some such as Kenya may only provide a 'letter of comfort/support', which may not be binding. Alternatives are a national bank guarantee or fund, a corporate guarantee fund, or relying on legislative support: for example, payments to IPPs are secured by a law governing funding allocation in the electricity sector of Cote d'Ivoire. Some countries' auction programs – eg, Argentina – offer their own guarantees against offtaker risk.

If the utility is state-owned, a renewables developer can mitigate against offtaker risk with an insurance product or guarantee that protects against government-owned entities reneging on their financial obligations. For example, the African Development Bank provided a $12.7-million partial risk guarantee for the 105MW Menengai geothermal project in Kenya.

Partial or political risk guarantees face many of the same challenges as cited above. In addition, they only cover debt lenders, leaving equity holders still exposed to the risk, and will not cover all of the investment or loan. This is why the project company may want a sovereign guarantee as a complement, but – as discussed above – these are hard to come by. In addition, some partial risk guarantees do not cover privately owned utilities: many emerging markets have government-owned offtakers – some 90% of the 71 countries covered by the Climatescope project.

Partial credit guarantees are more flexible, as they cover private lenders against all risks for the debt portion of the financing during a specific period. For example, they can be used to guard against currency and transfer risk caused by government action and to tackle technology risk. Such tools may also be used to improve the credit worthiness of the state-owned offtaker and facilitate local debt financing.

5.7. Land tenure

One land-related risk that appears more common in emerging markets concerns ownership. In such situations, investors may face increased costs due to legal cases and delays, and damage to reputation, and they may have to write off a considerable sum if the project is abandoned. As shown in Table 8, many of the land-tenure disputes to date have related to wind and hydro plants.

Table 8: Example projects affected by land-tenure disputes

Project	Companies involved	Technology	Country	Status
Damanjodi	Orissa Renewable Energy Agency			Canceled
Eolica Marena	Macquarie, Mitsubishi Corp			Canceled
Foum El Oued	Nareva, Siemens			Delayed but commissioned
Gibe III	Ethiopian Electric Power Corporation			Delayed but commissioned
Kinangop	Aeolus Power			Canceled
Marena Alterna Istmena	Macquarie, Mitsubishi Corp			Canceled
Mong Ton Dam (Tasang)	China Three Gorges, Sinohydro, China South Grid, EGAT			On hold since 2008

Source: Business & Human Rights Resource Centre, BNEF *Key* *Wind* *Large hydro*

Land-tenure disputes remain a significant challenge in Sub-Saharan Africa, affecting several renewables projects. More than two-thirds of land in the region is under customary tenure – ie, it is owned by indigenous communities and administered according to their customs. Rights to land are rooted in communities and typically not written down or legally recognized. But many national land laws are based on the European legal concept focused on individual land rights and ownership.

To mitigate this risk, a developer should integrate land issues into its due-diligence process, and undertake initiatives to educate and engage the local community (see box) as early as possible in the project process. For example, in Kenya, the developers of the Kipeto wind farm have established a community development trust, through which 5% of the wind farm's dividends will be invested in health, education, and other social projects to benefit local residents. Engaging a local partner may be advantageous. Some established renewable energy developers already have or are working to implement a detailed process to consult the community and tackle any grievances. They can implement leasing arrangements or benefit-sharing agreements where

locals are paid for the wind turbines or solar panels located on the land they occupy. Governments can also help by establishing dedicated pieces of land for renewables projects, as they have done in Egypt, Jordan and Turkey.

5.8. Grid connection

This risk arises if a renewables developer encounters problems in connecting its project to the grid. Uncertain grid access has a big impact on determining the commercial viability of a new power project, and preventing plants from connecting to the grid can delay financial close and deter investors. For example, Chile is divided into four power systems, which are not interconnected and power cannot be traded between them. As a result, several big grid enhancement projects are under way but they may still not prove sufficient to absorb the considerable volume of new wind and solar capacity now expected on line by 2020. This trend is reflected in Chile's Climatescope score, which jumped to second position in 2016, but dropped again this year.

A developer could use a partial risk guarantee (depending on its coverage) to cover transmission network and interconnection risk, as for the Lake Turkana wind farm in Kenya (see box). Not only does this increase costs but it is also only possible where the transmission system operator is state-owned, as is the case in many emerging markets. In some countries, the risk of grid connection may be low because the government requires developers to build the necessary infrastructure as part of their renewables project such as in Russia (for a considerable cost).

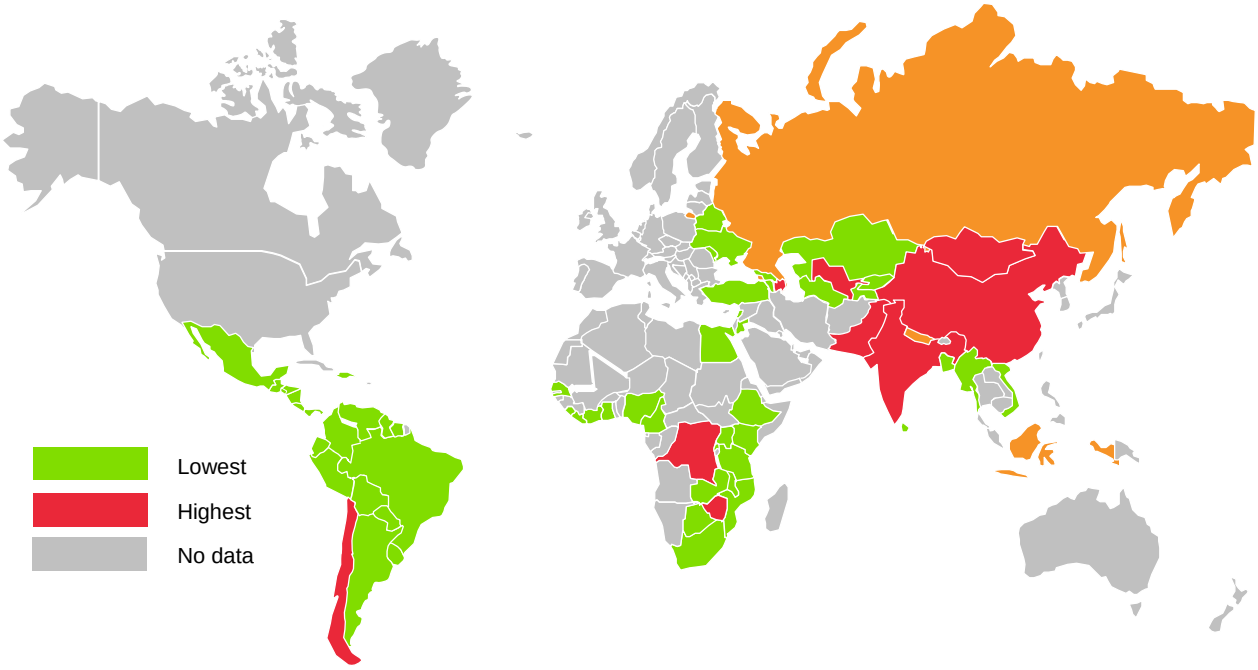
Grid connection risk: Kenya

The partial risk guarantee in Lake Turkana – AfDB's first – played an important role in the project reaching financial close. This was because it covered the risk of delay in the construction of the 428-kilometer state-owned transmission line between substations required to connect the wind farm to the national grid. AfDB's decision came after the World Bank's International Development Agency refused to provide a partial risk guarantee to the project because the Kenyan government would not offer a counter-guarantee (though it did issue a letter of support).

5.9. Curtailment

This risk occurs when wind and solar plants are forced to reduce their output, without compensation for curtailment. Figure 70 shows some of the hot spots for this risk. China has the worst curtailment rates in the world, with the national average ratio in 2016 at 17% for wind and 10% for solar. Consequent financial losses amount to an estimated $3.4 billion last year. A plant experiencing the current level of curtailment in China throughout its lifetime would need to sell power at a price almost a fifth higher than expected when commissioned in order to make the anticipated rate of return.

Figure 70: Curtailment risk in emerging markets based on Climatescope project results



Source: Bloomberg New Energy Finance

Much of the 'mitigatability' of this risk lies with the government and offtaker, given that curtailment ratios are significantly affected by the power demand-supply balance, penetration of variable renewables, and the capacity and flexibility of the grid. Since investment in grid infrastructure is typically not the responsibility of renewable power generators, a developer should take into account curtailment risk (current and future) and any compensation available when deciding project site location. In many emerging markets, the offtaker covers curtailment losses as part of the electricity tariff, making the issue of curtailment a critical part of the PPA negotiations.

Curtailment risk: China (2)

The National Energy Administration has released maps flagging provinces with high curtailment risk. A province with a 'red alert' does not receive a 'development quota' for the following year, meaning that local government cannot approve new projects and connect capacity to the grid.

BNEF analysis indicates that the 2017 maps were too lenient. It expects the national curtailment ratio to decline in coming years. But at a provincial level, Shaanxi may see curtailment worsen by 2020 and the risk is due to emerge in four new provinces.

Wind developers in China have found four strategies: focus on less curtailed low wind regions with relatively stable cash flow and higher profitability; expand to overseas markets to diversify their asset portfolio; seek corporate procurement deals selling power directly to local large-scale costumers at lower prices; and lock down and accelerate good quality pipeline projects.

Figure 71: China renewables curtailment

2016

2020

Source: Bloomberg New Energy Finance

As well as investment in grid infrastructure, there is a number of strategies that the government and offtaker can pursue, including reforming the power market, establishing a competitive wholesale market based on economic dispatch and requiring renewable energy developers to provide system services. Energy storage is being trialed in a number of countries. In June 2017, Qinghai province announced that wind developers must install energy storage equivalent to a tenth of a project's capacity to secure a grid connection.

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