Global Green Growth Institute

SPECIAL REPORT FOR ASIAN REGIONAL POLICY DIALOGUE

# Pushing the Envelope on Renewable Energy

Jeju Island, Republic of Korea
September 7, 2016

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This report, together with the discussion on the day of the Dialogue, will serve as the basis for a continued deliberation in the future.

# Acknowledgement

This report was prepared under the guidance and leadership of Mahua Acharya, Assistant Director-General of the Investment and Policy Solutions Division at GGGI.

Jaeseung Jason Lee and Hyunjee Oh (GGGI) conceived, co-authored, and coordinated the report.

Prasoon Agarwal (GGGI), lead author for the report, provided technical oversight and led the research, analysis, and writing effort.

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- Steering Group Meeting, China: 31 May 2016
- Steering Group Meeting, Indonesia: 22 June 2016

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Darren Karjama (GGGI), Daniel Muñoz-Smith (GGGI), and Swati Lal (GGGI) carried editorial responsibility.

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# Glossary

The following abbreviations and definitions are used within the report.

| Abbreviation | Full form |
|---|---|
| AD | Accelerated depreciation |
| COP21 | Conference of the Parties 21 |
| ECAs | Export credit agencies |
| ESS | Energy storage systems |
| EVs | Electric vehicles |
| FIT | Feed-in tariff |
| FODER | Fund for Renewable Energy Development |
| GBI | Generation-based incentives |
| GGGI | Global Green Growth Institute |
| INDC | Intended Nationally Determined Contribution |
| IPP | Independent power producer |
| LCOE | Levelized cost of electricity |
| LCOS | Levelized cost of storage |
| Li-ion | Lithium-ion batteries |
| O&M | Operations and maintenance |
| PHS | Pumped hydroelectric storage |
| PLN | Perusahaan Listrik Negara |
| PPA | Power purchase agreement |
| RE | Renewable energy |
| RPO | Renewable Energy Purchase Obligations |
| UDAY | Ujwal DISCOM Assurance Yojana (utility reform program in India) |
| VGF | Viability Gap Funding |

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# Summary

**The transition to clean and sustainable energy is being prioritized on a global scale, driven by a host of economic, environmental, and social factors.** In its efforts towards this shift, Asia can take advantage of maturing technologies (reducing costs), more reliable forecasting, and the competitiveness of renewable energy (RE) compared to conventional power, especially as combined RE and energy storage solutions develop. Additionally, reducing dependence on energy imports and strengthening energy security would be focal points of national agendas. In this context, accelerating the transition to a renewables-based energy system also represents a unique opportunity to meet several goals: mitigating greenhouse gas (GHG) emissions as committed to in the Paris Agreement, fueling economic growth, reducing air pollution, creating new employment opportunities, reducing health care costs, and enhancing overall human welfare. The falling costs of RE technologies are "leveling the playing field" with traditional energy generation sources in Asia. The continual decline in technology costs is being driven by increasing RE deployment throughout the world, creating economies of scale in manufacturing processes, as well as advancements in the technology itself.

**A renewable energy transformation is already underway in Asia.** While RE encompasses a wide range of environmentally sustainable power generation sources, solar and onshore wind technologies have shown the greatest potential for rapid scale-up within the Asian countries. The sizeable manufacturing bases in China and India for wind turbines (and solar panels in China) have contributed significantly to this transformation. The Asian economies are making strong progress in adopting RE, with China and India leading this transformation and other Asian countries cashing in as RE costs begin to fall. The Asian region as a whole is expected to see significant growth in power demand in the near future, as electricity consumption is forecasted to double between 2016 and 2030, and with it, the market growth potential for the RE sector, thereby creating huge investment opportunities in this arena. Moreover estimates show that increasing the global investment in RE will be paramount to achieving the 2°C limit, with figures suggesting a needed RE investment of US$12.1 trillion between now and 2040, almost double the "business as usual" expectation of US$6.9 trillion over the same period.

**There are already several success factors that have led to the adoption of renewable energy in the Asian region.** Key measures and success factors, centered around policy, economics, and resource availability, have influenced, and will continue to influence, the adoption of RE in the Target Countries, namely China, India, Indonesia, the Philippines, Thailand, and Vietnam. Setting out ambitious renewable energy goals and designing appropriate supporting policies, such as RE targets, Feed-in Tariffs, tax breaks etc., have been critical to increasing the uptake in several countries. In addition, economic factors, such as reductions in the cost of RE technology—thanks to China and India becoming major production centers for cheaper wind turbines and China becoming the world leader in the low-cost manufacturing of solar PV modules—have greatly facilitated the deployment of these technologies by boosting their cost competitiveness. Last, but not the least, the vast untapped natural resource potential existing within the Target Countries has also been a critical enabler for the transition to increased RE deployment.

**Challenges still remain to be addressed, and innovation is key.** Consistent and certain RE policy is fundamental in demonstrating a long-term governmental commitment to building a sizeable RE industry in the economy. To date, limited funding options have been available for RE projects in most Target Countries, constraining the scale of RE development. While most funding has come from commercial lenders, the amount of capital available from these private sources is limited. The sophistication of financial instruments is yet to develop, and there remains significant potential for designing financing models that can draw in different sources of capital. Innovative financing models are needed in order to both reduce risk and achieve scale. Particular challenges that could be addressed by such instruments include risks associated with project development, the level of which depends on a variety of factors, such as the creditworthiness of the off taker, foreign exchange rates, interest rate volatility, and inflation.

**Government remains at the driver's seat.** Several entities can play a vital role in further accelerating the transition towards renewable energy but government is entrusted with the responsibility of creating the right investment conditions for maximize RE deployment, through the formulation of forward-looking policies, the provision of stable regulatory frameworks, the resolution of economic barriers (like land availability), the creation of adequate grid capacity and the facilitation of market reforms that internalize the true cost of fossil fuel-based power. Private sector participation, either directly or through innovative (hybrid) financial models, is the real key to realizing the significant investments required in meeting each Target Country's RE goals, since governments alone may not meet the required capital investments. International agencies also have an important role to play, by facilitating regional cooperation amongst countries for sharing best practices, assisting in capacity building, and helping to design and operationalize financial instruments, especially for risk reduction.

**Several measures can be undertaken to push the renewable energy envelope further.** To unlock the next phase of growth, all Target Countries must look for new ways of enhancing private-sector participation in their respective RE markets. Governments can rely on a host of policy measures to facilitate increased participation based on the unique conditions of their respective countries. In the short run, measures such as tax incentives, feed-in tariffs, and payment security mechanisms can be employed to cover offtaker risk. In the long run, governments can work towards implementing more challenging measures like streamlining approval processes and upgrading grid infrastructure to ensure the capability of managing the increasing penetration of intermittent generation sources and reducing the risk of curtailment. Additionally, governments can focus on key areas to enhance the attractiveness of their national RE sectors, and further accelerate private-sector financing in RE through the development of innovative financial instruments.

# Background: Objectives of the Report, Main Challenges, and Key Actions

## Background

The Global Green Growth Institute (GGGI) is hosting the Global Green Growth Week 2016 (GGGW2016) on September 5–9, to identify practical and innovative solutions to sustainability challenges and to strengthen partnerships for delivering pro-poor, inclusive and environmentally sustainable growth. The Asian Regional Policy Dialogue (the Dialogue) will be one of the major events at the GGGW2016. Its primary objective will be to stimulate discussion on the topic of scaling up Renewable Energy (RE) in Asia. The Dialogue will gather high-level government officials from Asia's energy and finance ministries, as well as experts and practitioners from the public and private sectors. They will discuss implementable policy options that address the challenges associated with the deployment of RE, and share experiences on strategic measures for overcoming barriers to clean energy investment.

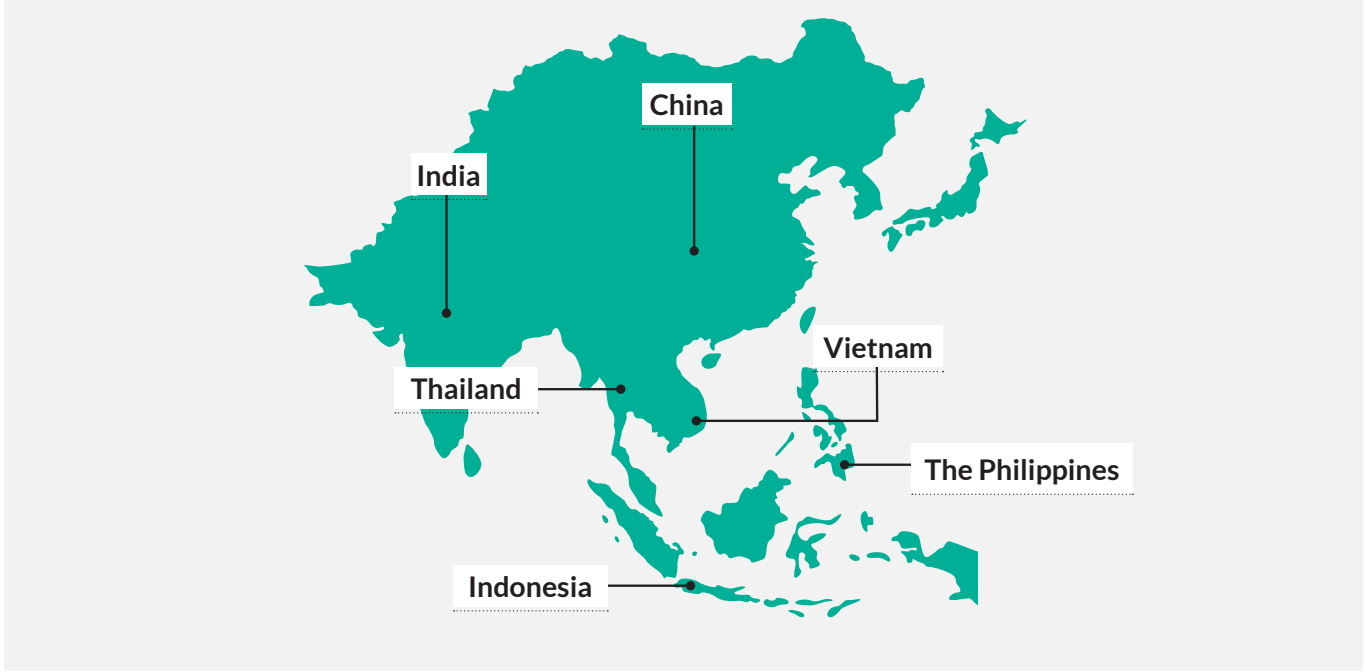
In facilitating and developing this Dialogue, GGGI has produced this special report, the findings of which will be presented for substantive discussion during the GGGW2016.

## Objectives of the report

This report aims to answer why and how some countries within Asia (referred to as the Target Countries) have achieved success in attracting RE investment, barriers to furthering RE deployment, and the policy measures and practical interventions that may help to overcome these barriers.

The Target Countries (Figure 1) have been researched in terms of their respective key growth drivers and challenges for RE, with a particular focus on China, India, and Indonesia (having the larger geographic and population footprints, these countries therefore have a greater potential for scaling up RE generating capacity), alongside highlights from the Philippines, Thailand, and Vietnam.

Figure 1: Target Countries discussed in this report



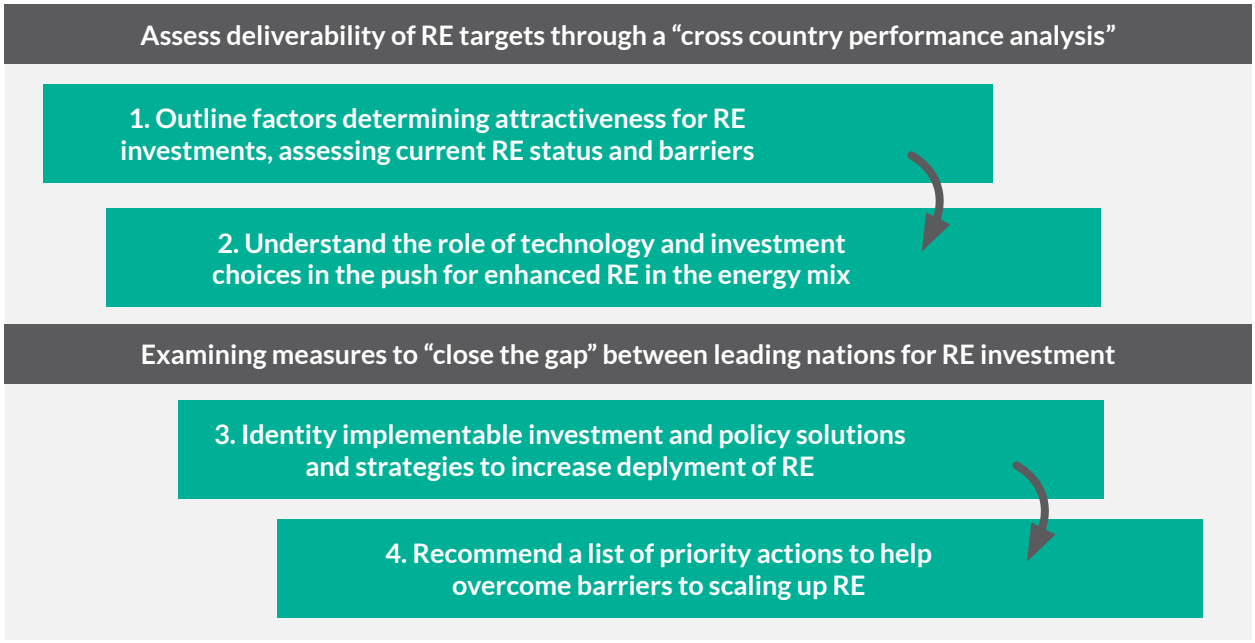
Each of these Target Countries is at a different stage and direction of RE development. While some of the Target Countries (namely, China and India) are more advanced in terms of their solar and onshore wind capacities, each of the countries has room for growth in RE. Therefore, all of the Target Countries can benefit from the Dialogue and this report, in addressing potential impediments to furthering RE deployment within their territories.

While RE encompasses a wide range of environmentally sustainable power generation sources, this report focuses primarily on solar and onshore wind, as these technologies have shown the greatest potential for rapid scale up within the countries of focus. The unique characteristics of each country's power sector must, however, be recognized wherever possible, noting in particular that some may already have established strong RE sectors using other technologies, such as hydroelectric power and geothermal (potentially alongside wind and solar), with strong potential for further growth here too.

All Target Countries, however, including those relatively less advanced in solar and wind energy installations, have begun to take positive steps towards kick-starting and / or accelerating this growth. For example, Indonesia and Vietnam recently announced new measures supporting mechanisms for solar PV development. Thailand and the Philippines have also enjoyed recent successes in both wind and solar technologies.

Therefore, the report seeks to consolidate these findings, bringing forward the experience of more developed markets in helping those less developed RE markets anticipate and overcome similar, potential barriers along the way. Its key objectives (Figure 2) in doing so are as follows:

Figure 2: Objectives of the report




The key findings for each of the Target Countries are examined in the context of five dimensions (Figure 3).

Figure 3: Five dimensions for the analysis of Target Countries' RE growth drivers

| Resources | Policy | Financial | Economic | Technical |
|---|---|---|---|---|
| Natural availability of resources for various RE technologies | Establish national RE targets and their achievability. | Availability of domestic capital for investment in RE | Competitive advantage of RE versus other conventional generation sources | Technical ability to increase RE (e.g. grid capability to balance intermittent generation |
| Practical accessibility to utilize RE resources | Supporting regulations, frameworks, and mechanisms enabling RE investment | International investment in country's domestic RE sector | Other economic factors (e.g. presence of domestic manufacturing base for RE technology) | Other technical constraints on project development (e.g., remote location, infrastructure access) |

The focus of the report is on the deployment of RE and its role in the power (generation) sector. As such, other areas related to electricity consumption, such as heating, energy efficiency, and transport, are beyond its scope and are, therefore, not considered herein.

It does, however, seek to conclude by offering recommendations and providing a brief discussion on the road ahead for RE in each Target Country. Finally, the report takes a look at two key areas of interest in the energy sector—energy storage and off-grid solutions, respectively. Recent developments in these fields are summarized along with an examination of the potential for their adoption in the Target Countries in tandem with RE, keeping in mind the fact that associated financing options remain at an early stage.

## Main challenges to scaling up RE

Following the identification of the factors leading to successful RE deployment within the Target Countries to date, the main challenges that may impede further deployment are outlined (Figure 4). For a detailed discussion and additional remedial measures, see the section *Addressing the main challenges to scaling up RE (5 dimensions)*.

Some of these challenges are not exclusive to RE, applying across the entirety of the power sector. Tackling them is therefore critical to the facilitation of wider investment in the electricity market as a whole.

Figure 4: Main challenges in scaling up RE in the Target Countries

| |
|---|
| **ENSURING CONSISTENCY AND CERTAINTY OF RE POLICY** |
| In order to support a long-term growth platform and investment pipeline, a country's economic environment must ensure investor access to capital at competitive prices. This requires long term consistency and certainty in national RE policies. |
| Once Feed-in-Tariffs or capacity quotas are in place, investors need to see long-term commitment from the government in building a sizeable RE industry in stages that are consistent with the country's power requirements. |
| **ENABLING ACCESS TO DIVERSIFIED FINANCING SOURCES** |
| Public funding of RE is not expected to increase beyond the current rate of 15% globally (IRENA 2016). |
| To date, limited funding options have been available for RE projects in most Target Countries, constraining the scale of RE development. |
| While most funding has come from commercial lenders, the amount of capital available from these private sources is limited. |
| To ensure sufficient capital is available and accessible to meet their RE objectives, countries must look at alternative funding sources, such as developing a project bond market, encouraging the participation of domestic institutional investors (through the insurance markets and local pensions funds) and other financing models. |
| Promoting the securitization and refinancing of operational RE assets can further help to free up bank capital for use in funding new construction. |
| **PROJECT DEVELOPMENT RISKS IN DEVELOPING MARKETS** |
| The creditworthiness of the offtaker is a key investment concern in cases where utility credit ratings are lower than those for other established power sectors. |
| India has managed to overcome this challenge in most states through the financial reform of its utilities and the use of central aggregators for wind power purchases, thereby switching the ultimate purchaser of RE. |
| Indonesia's announcement of a separate RE offtaker from its main utility PLN would follow a similar approach which could be replicated across other Target Countries where the risk of relying on the main utility for procuring RE remains a barrier (such as Vietnam). |
| Experience shows that macroeconomic risks such as foreign exchange / interest rate movements and inflation create further uncertainties for both domestic and foreign investors. |
| Currency risks can be mitigated through the use of domestic capital and/ or hedging products supported by government. |
| Macroeconomic risks, coupled with embedded project risks, may increase the financing costs for RE projects in the Target Countries |

**RELIANCE ON CONVENTIONAL GENERATION: STRIKING THE RIGHT BALANCE BETWEEN CONVENTIONAL FOSSIL FUELS AND RE**

An abundance of domestic coal reserves and other fossil fuels alongside the need for affordable power may initially favor conventional generation.

However, the economic argument for fossil fuels cannot be objectively compared to the investment case for RE without taking into account the wider benefits, including the avoidance of costly fossil fuel imports and increased energy security as a result.

When devising an investment policy for the overall energy mix, governments should take into account these considerations, as well as the unquantifiable benefits from RE, such as improved effects on health.

The need to maintain a 'baseload' level of conventional generation and electricity access will ultimately need to be balanced with the benefits of falling costs of RE technology

**TACKLING GRID CURTAILMENT[1] TO ENSURE RE GENERATION IS MAXIMIZED**

A mismatch between areas of high power supply from renewables (typically where RE resources are strong and land is accessible) and those with high power demand (often urban concentrations located some distance away) can lead to significant electricity transmission losses which could frustrate large-scale RE roll-out.

Off-grid and distributed energy generation sources located closer to these centers of electricity consumption help to both reduce losses and to encourage the uptake of small-scale generation, further favoring RE.

Connecting intermittent RE (i.e. wind and solar) can be seen as a strain on older grid networks, resulting in curtailment of energy dispatch in the management of power demand and supply fluctuations.

Nevertheless, RE helps to stabilize grid networks by balancing often negatively correlated existing technologies, including hydropower and geothermal.

As the deployment of RE increases, proper planning and investment in the grid infrastructure will be critical.

Periodically examining the economic case for combining energy storage and RE systems by monitoring developments in the area and the associated costs, will help to open up a wealth of new solutions for grid operators and policymakers in meeting the energy challenges of the future.

# Priority action items

In addressing these challenges, certain priority actions have been identified. Naturally, the applicability of these actions varies by country and, with them, the areas of focus that each country should prioritize for attracting investor interest in their respective RE sector.

It is important to note with the areas of investor focus (discussed below) that:

- Differing levels of government intervention are required for each action: e.g., while more developed RE markets may have already transitioned towards private sector financing, others will require policy support to jump-start private sector participation. Getting the balance of policies correct is as important as determining which policy interventions to make in the first place, in order to build and maintain investor confidence.

- Encouraging large, international investor participation and new forms of capital (e.g. pension funds) may only be applicable to certain countries. Regulations restricting investment in insurance and pension funds can pose an immediate barrier to investor support of RE in more developing markets.

- If such investors are also not already active in a particular country, there may well be wider systemic issues that must first be addressed, before they will invest in RE.

These areas are discussed in further detail alongside possible solutions in the section titled *Closing the gap: Measures and strategies to scale up RE*, which explores closing the gap between the leading and developing Target Countries.

1 Curtailment is a reduction in the output of a generator from what it could otherwise produce given available resources, typically occurring on an involuntary basis (NREL, 2014)

Figure 5: Summary of key areas of investor focus and action items for scaling up RE

| | | |
|---|---|---|
| 1 | **Prioritize grid investment in parallel to direct RE support** | |
| | **Invest in grid upgrades and expansion** to balance intermittent RE generation and reduce curtailment as seen in rapid-growth markets | |
| | **Incentivize generation (output)** above installed capacity of RE | |
| | **Invest in off-grid solutions** to alleviate energy poverty in remote areas | |
| | **Integrate energy solutions** as utility-scale commercial technologies become more widely utilized, bringing down costs | |
| 2 | **Manage robust market mechanisms for supporting RE** | |
| | **Define clear, long-term targets for RE as a share of the energy mix to attract long term investors** alongside supporting policy measures to enable them to build a sizable portfolio | |
| | **Set clear evaluation criteria and time-lines** for tariff awards to build investor confidence and encourage international participation | |
| 3 | **Accelerate private sector capital in RE** | |
| | **Create a domestic financing sector for RE projects** through capacity-building in project financing at local financial institutions | |
| | **Facilitate design and implementation of financial products to de-risk private investments**, such as insurance cover for RE projects | |
| | **Attract new forms of private capital** through Public-Private Participation structuring, encouraging local institutional investor participation, and reducing associated costs of transactions. | |
| | **Utilize international sources for climate finance** to support investments where other lending routes may be restricted | |
| 4 | **Recognize cost-competitiveness and indirect benefits of RE** | |
| | **Revisit FITs over time** to reflect falling technology costs | |
| | **Move to Reverse Auctions to enable price-competition** as the market matures and local supply chains become established for renewables | |
| | **Measure, recognize and reward the indirect external benefits of RE** including energy security and fiscal savings from reduced balance of payments, utilizing cost savings to further drive RE deployment | |
| | Encourage long-term policy-making based on these savings | |
| 5 | **Facilitate project structuring and mitigation of in-country risks** | |
| | **Establish mechanisms to mitigate in-country risks** such as off-taker default, through central government guarantees and utility reforms | |
| | **Support project development** though conducting initial feasibility studies, streamlining project approval procedures, and providing government-owned land and supporting infrastructure to RE auctions. | |

# Renewable Energy in the Asian Context

## Prioritizing the transition to clean energy

The Target Countries are recognizing the need to develop clean and sustainable energy policies to help combat global climate change and local environmental concerns, while delivering affordable power and maintaining economic growth. Shifting to RE plays a key role in meeting these national objectives. Moreover, there is a pressing global need for a transition to RE, as summarized in the following figure.

Figure 6: Prioritizing the transition to clean energy – the climate change imperative


*Source: World Bank 2016*

Bloomberg New Energy Finance estimates that achieving the 2°C limit will require global investment in RE to almost double, from the current "business as usual" expectation of US$6.9 trillion through to 2040, to US$12.1 trillion (BNEF 2016) over the same period.

The Asia-Pacific region is expected to invest US$6.1 trillion in its energy sector as a whole over this period, leaving significant ground to be covered on RE if the global imperative climate target is to be achieved.

## Why transitioning to clean energy makes economic sense

In addition to the global community's wide (and growing) recognition of the fact that carbon emissions must be drastically reduced if we are to achieve "well below" the 2°C limit, the international policy shift towards RE deployment is being driven by three other key influences.

Figure 7: Additional influences driving the global adoption of RE

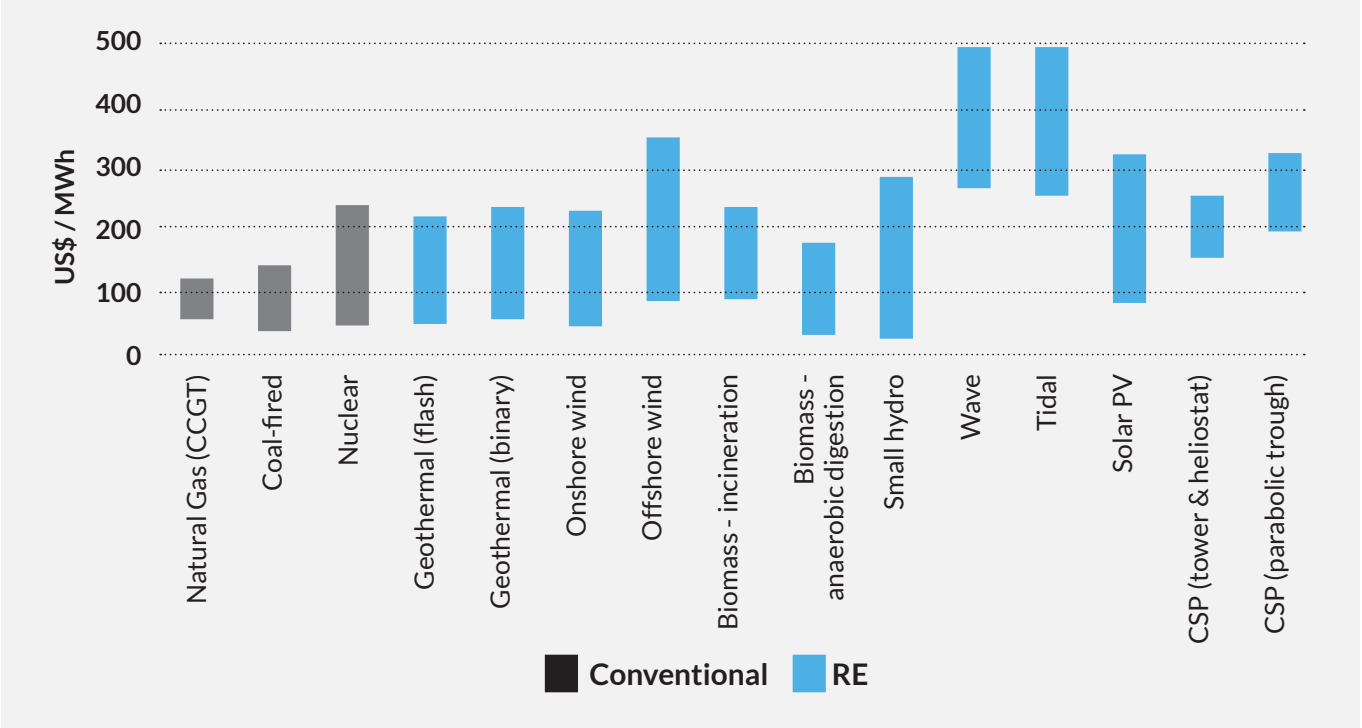
| Energy security | Economic case for RE | Environmental-Social benefits |
|---|---|---|
| Reducing the need to rely on energy imports, thereby strengthening energy security as well as increasing capabilities to trade power internationally | Taking advantage of the global maturity of technology (reducing costs), more reliable forecasting, and competitiveness of RE when compared to conventional power (especially as combined RE and energy storage solutions develop) while creating jobs | Follow-on benefits such as economic growth, GHG mitigation, and reduction in air pollution, thereby reducing health care costs |

Furthermore, following the 2015 Paris Agreement, investors began to perceive the risks of continued investment in conventional power. This freed up sources of capital for RE investment, and has already resulted in strides in fossil fuel divestment in favor of RE.

Together, the above influences have seen the costs of RE move towards the tipping point (grid parity) where RE achieves an economic advantage over fossil fuels, as certain countries around the world see the cost of RE generation start to fall below that of conventional generation.

Figure 8 shows the Levelized Cost of Electricity (LCOE) - a measure that enables the cost of generation to be fairly compared across different sources – showing that RE (in blue) is beginning to compete on cost against conventional power (highlighted grey) on the global stage:

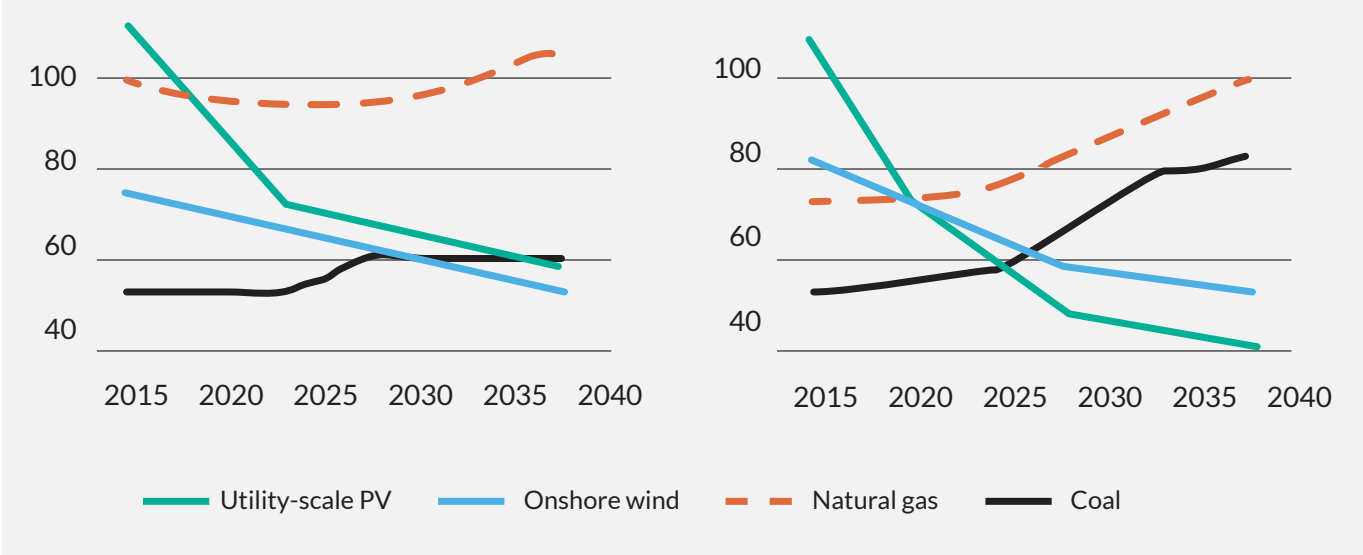
Figure 8: LCOE ranges for RE and conventional (fossil-fuel based) generation sources




*Source: BNEF 2015*

Further, the graphs below (Figure 9) illustrate the continued downward trajectory forecast for RE generation costs in China and India—the two Target Countries with the highest RE capacity. This is expected to result in a tipping point in both countries, though at different points in time for each, driven by the status of their respective coal-fired power sectors.

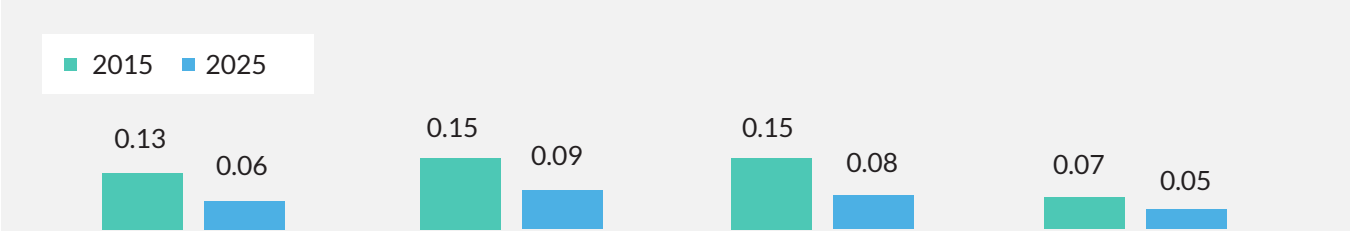
Figure 9: China (left) and India (right) - LCOE forecasts (in US$/MWh nominal)




*Source: BNEF 2015*

RE cost reduction projections are further reinforced when examining the period to 2025: not only are upfront investment costs for primary RE technologies expected to decline by 12% (onshore wind) and 56% (solar PV), but capacity factors, i.e., the efficiency with which these technologies generate energy, is also expected to increase by 11% and 6% respectively, resulting in an overall reduction in their respective LCOEs of 26% and 59% (IRENA 2016), as illustrated below.

Figure 10: LCOE reduction for solar and wind technologies, 2015 to 2025 (in 2015 USD / kWh)




*Source: IRENA 2016*

**Technology improvements in onshore wind**
Advancements in generating efficiency have led to a 150% improvement in average capacity factors for onshore wind globally (excluding China), reaching up to 25% in 2015 against just over 10% average capacity factor in 1998. This is set to increase further to 37% by 2040 (BNEF 2016).

A key advantage for developing Target Countries with significant RE potential is the ability to benefit from these LCOE reductions alongside further improvements in efficiency as the technology matures (see left box).

As natural resource forecasting has also become increasingly more reliable, costs of financing (which reflect the level of inherent risk in forecasting) have correspondingly fallen for proven technologies.

**The fossil fuel versus RE debate**

In 2015, annual RE investment in developing countries worldwide exceeded that in developed nations for the first time (US$156 billion compared to US$130 billion); China accounted for 36% of the global total with India also in the top-five by investment (REN21 2016).

While the fossil fuel versus renewables debate has long been referred to as a binary decision, the recent drop in oil prices has brought it into ever-sharper focus.

However, if anything, this low cost environment prompts demand to continue to drive down RE costs, while prompting countries to consider more keenly the broader external benefits that RE can bring in terms of energy access, economic growth, and reducing harmful effects on health.

Even with oil prices fluctuating around US$50 per barrel and the natural gas renaissance in full flow, wind and solar power are equally affordable without subsidy, as the above analysis shows. Further, the cost of these technologies is predicted to continue to decline over the next few decades – it is unclear whether the same can be said for fossil fuels.

To assist Target Countries in shaping the future of their RE sector, this report aims to capture best practices and experiences in leveraging the falling costs of renewables.

## Powering Asia's economies

In recognizing both the climate change imperative and economic case for RE, it is important to put each Target Country's relative stage of electrification (energy access) and progress towards clean energy transformation into context.

The Asia region as a whole is expected to see significant growth in power demand, as electricity consumption doubles from 2016 to 2030 (ADB 2016). This growth in demand, driven by factors discussed below, will create investment opportunities in parallel, as they demonstrate strong market growth potential for investors in the off-grid RE sector:

- **Robust economic growth:** Southeast Asia's economies, as a whole, are set to triple in size by 2040 (IEA 2015), while annual GDP growth of around 6% in China and above 7% in India are forecasted through to 2020 (IMF 2016).

- **Sizeable growth in population:** Southeast Asia's population alone is expected to grow by almost a quarter from 616 million in 2013 to 760 million in 2040 (IEA 2015), while population growth of around 0.5% and 1.3% per annum, in China and India respectively, are anticipated to continue (World Bank 2016).

- **Increasing energy demand:** a consistent increase in urbanization throughout Southeast Asia has seen the urban populace increase from 15.4% of the total population in 1950 to 41.8% in 2010, resulting in considerable associated power demand. This trend is expected to continue towards 49.7% urbanization by 2025.

- **Reducing energy poverty:** Particularly in more remote parts of India, Indonesia, and the Philippines (which have national electrification rates of 81%–88%), coupled with rising standards of living, make alleviating energy poverty, a key government priority.

Figure 11 summarizes the Target Countries' projected energy needs, drivers and energy plans.

Figure 11: Target Countries' current and forecast energy needs

**India**

Installed capacity: 304GW

Electrification: 81%

Need to provide electricity to unserved population, burgeoning middle classes and an increasingly urbanized population

Per-capita electricity consumption: 1,010 kWh (2015), a third of the global average of 2,803 kWh

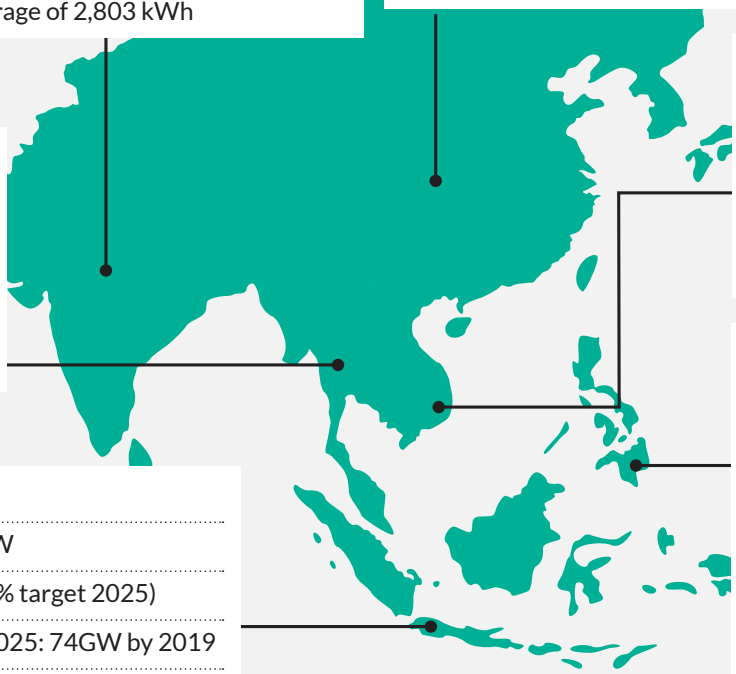
**China**

Installed capacity: 1480GW

Electrification: 100%

Electricity consumption grew 0.5% year-on-year in 2015

This against a historic annual growth rate of 7.3% from 2006 to 2014 due to recent global economic slow down and the country's transitioning away from heavy industry



**Vietnam**

Installed capacity: 37GW

Electrification: 98%

Forecast peak load by 2030: 91GW

**Thailand**

Installed capacity: 40GW

Electrification: 100%

Forecast peak load by 2036: 49.6GW

**The Philippines**

Installed capacity: 18GW

Electrification: 87.5% (90% target 2017)

Forecast demand by 2030: 29.3GW

Energy Plan 2012-2030 aims to install 25.8GW by 2030 (still short of projected demand)

**Indonesia**

Installed capacity: 52GW

Electrification: 88% (98% target 2025)

Forecast peak load by 2025: 74GW by 2019

Bring power to 10,300 remote villages

35GW procurement program

# Cross-country performance analysis

## Leading Target Countries by installed RE capacity

All of the Target Countries have a large installed RE capacity (Table 1) underpinned by a long history of hydropower (and in some cases geothermal) generation. The following are key highlights for each:

- China now has the world's largest portfolio of wind and solar capacity with an installed capacity of 128GW and 41.5GW, respectively, in 2015 (China National Renewable Energy Centre n.d.). In addition, a recent study suggests that China may have already reached 'peak coal' during 2013–14, indicating the decoupling of economic growth from coal consumption (LSE and Tsinghua University 2016).

- India has also embraced wind and solar on a large scale, having the fourth- and eighth-largest installed capacity of each respective technology globally (BNEF 2015).

- Vietnam has the largest RE portfolio as a percentage of its total installed capacity because of its large hydropower installations, but has yet to adopt wind or solar technologies.

- Thailand has had successes across all RE technologies, including hydropower, biomass, wind, and solar, with the potential for further growth as the country faces an energy transition due to declining domestic gas reserves.

- The Philippines and Indonesia are the world's second- and third-largest geothermal markets, respectively. The Philippines has registered successes in wind and solar from its first FIT framework, which is currently being renewed, while Indonesia has recently issued its first FIT regulation for the promotion of solar energy.

Table 1: Target Countries (left to right) by largest installed RE capacity (MW), 2015

| Country | China | India | Indonesia | Philippines | Thailand | Vietnam |
|---|---|---|---|---|---|---|
| Small hydro | 85,041 | 4,177 | 178 | 123 | 116 | 1,984 |
| Large hydro | 211,619 | 42,623 | 5,291 | 3,465 | 3,440 | 14,349 |
| Biomass and waste | 11,062 | 4,678 | 1,817 | 346 | 3,074 | 25 |
| Wind | 139,297 | 25,099 | 3 | 437 | 278 | 128 |
| Solar | 50,337 | 5,183 | 71 | 148 | 1,938 | - |
| Geothermal | 28 | - | 1,405 | 1,937 | 0 | 1 |
| Marine | 4 | - | - | - | - | - |
| Total | 497,388 | 81,760 | 8,764 | 6,456 | 8,846 | 16,487 |

*Source: BNEF 2015*

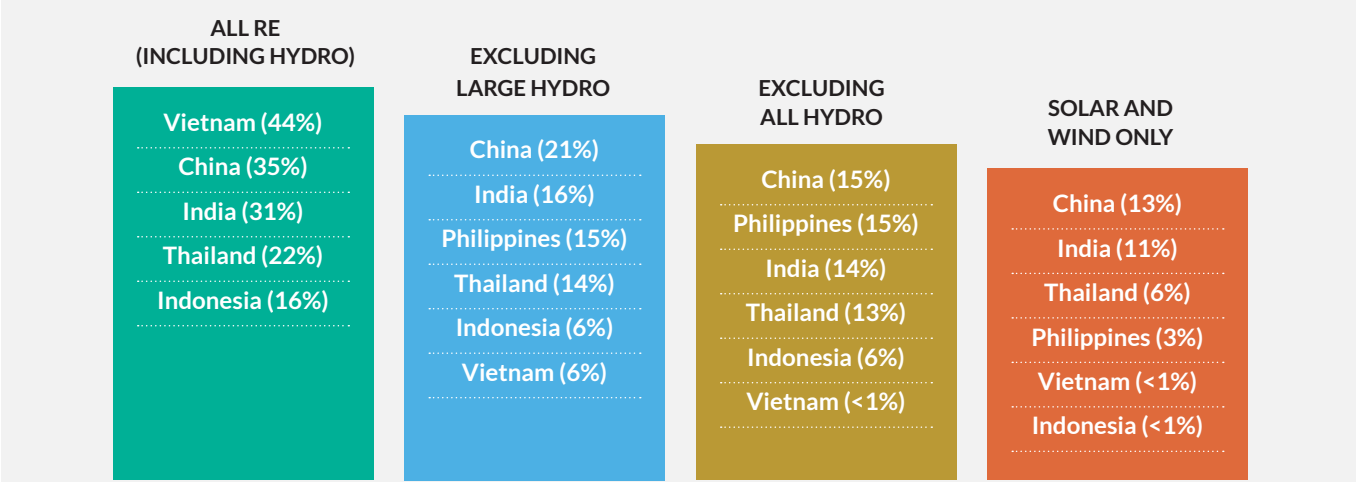
Examination of the generation mix by installed power generating capacity provides useful insights as summarized below and illustrated in figure 12.

- The share of total installed power capacity in each Target Country attributed to RE, including all forms of hydropower, is more than 15%.

- Large hydropower makes up a significant proportion of installed capacity in most countries, especially Vietnam (38%), the Philippines (18%), India (15%) and China (14%).

- Excluding all hydropower, RE's share of total installed capacity falls to less than 10% for Indonesia and Vietnam.
- The share of solar and wind in the generation mix across the Target Countries in Southeast Asia (i.e., excluding India and China) is less than 10%.

Figure 12: RE as a percentage (%) of overall installed power capacity in each Target Country (2015)




*Source: BNEF 2015*

While installed capacity provides an indication of a country's success in RE investment to date, the most relevant indicators for unlocking future growth in the industry are the success factors and potential interventions to further investment.

## Success factors in adopting RE in the Target Countries

There are several key measures and success factors, centered around policy, economic, and resource perspectives, that have influenced, or are likely to influence, the adoption of RE in the Target Countries.

By taking full advantage of these factors when designing policies for the rapid expansion of their power generation sectors, the Target Countries can be better positioned to bypass assumed reliance on fossil fuels, and to avoid the cost of "locking in" potentially obsolete technologies now, rather than replacing them with clean energy later on.

### 1. POLICY: SETTING OUT AMBITIOUS RE GOALS AND DESIGNING APPROPRIATE SUPPORTING POLICIES

The Conference of the Parties 21 (COP21) brought a renewed international consensus regarding the need to quickly transition from fossil fuels toward cleaner sources of generation. This consensus has been reinforced by the submission of "Intended Nationally Determined Contributions" (INDCs) by 162 nations (UNFCCC 2016), including the Target Countries, through which they have set national RE goals (Table 2).

Table 2: National RE goals across the Target Countries

| Target Country | National-level goals1 and specific technology targets (where specified) | Greenhouse gas reduction target[1] |
|---|---|---|
| **China** | **Overall goal:** 20% non-fossil fuels in primary energy by 2030<br>Wind: 200GW (2020)/300GW (2030)/1TW (2050)<br>Solar: 100GW (2020) | **By 2030:**<br>Peak $CO_2$ reduction<br>60%–65% reduction in $CO_2$ per unit GDP against 2005 levels |
| **India** | **Overall goals:** 175GW by 2022/40% installed capacity by 2030 (26%–30% of total generation)<br>Solar: 100GW<br>Wind: 60GW<br>Bioenergy: 10GW<br>Small-hydro: 5GW | **By 2030:**<br>33%–35% reduction in GHG intensity against 2005 levels |
| **Indonesia** | **Overall goal:**<br>17% RE by 2019<br>23% RE by 2025<br>RE to account for 8.8GW of 35GW program (25%), incl. 5GW solar[2] | **By 2030:**<br>29% reduction in GHG intensity |
| **The Philippines** | **Overall goal:** 25% from RE by 2021 15GW by 2030<br>Solar: 2GW<br>Wind: 1.2GW<br>Bioenergy: 3.63GW | **By 2030:**<br>70% drop from 2000 levels |
| **Thailand** | **Overall goal:** 20%–36% by 2030<br>Solar: 6GW<br>Wind: 3GW<br>Bioenergy: 5.6GW | **By 2030:**<br>20% reduction from BAU levels<br>25% reduction with international support |
| **Vietnam[3]** | **Overall goal:** 10% electricity production from RE (excl. large and medium-scale hydro and pumped-storage hydro) by 2030 (7% by 2020).<br>Wind: increase from 140MW to 6GW by 2030<br>Biomass: 2.1% of total generation by 2030<br>Solar: increase from negligible current level to 12GW by 2030 (3.3% of total power sources) | **By 2030:**<br>8% fall from 2010 levels by 2030 (unconditional INDC target)<br>25% fall with international support (i.e., conditional on e.g. technology transfer, capacity-building etc.)[4] |

*Sources: [1] MAKE 2016, [2] PLN 2016, [3] PDP 7 2016, [4] UNFCCC 2016*

Setting goals for RE deployment is an effective method of encouraging RE development. This may include publicly stating government's intentions to promote RE, thereby giving confidence to developers who are considering market entry.

In order to meet RE goals, enable initial investment, and increase installed capacity, each Target Country has begun to establish policy measures and regulatory frameworks, which are at various stages of maturity.

**Grid Integration should be a policy priority**
The exponential increase in renewable energy deployment was not anticipated when the initial integration studies were conducted by several countries. Hence, the lack of planning for grid integration is one of the critical factors constraining the large-scale deployment of RE, and there is an urgent need for policy focus in this area.

In addition, those countries with more established RE frameworks in place have recently shifted focus to incentivizing output from RE generation, rather than purely installed capacity (as is promoted by the above goals to increase nameplate RE capacity) (see box on the right). A summary of the key successes to date in terms of RE policy is set out below.

- China has set out ambitious top-down goals at the central government level that are being implemented and supported at the provincial level. The majority of the power industry is state owned (generation, transmission, and distribution), and can therefore gain access to state-backed funding at reduced rates. The unique factors present in the Chinese market have promoted substantial growth in installed RE capacity in recent years. The country's FIT regime has been credited with having catalyzed the market.

- Likewise, India has set out highly ambitious goals for the deployment of RE across the country, both at national and state levels. The Government has created a comprehensive support program to achieve these goals, including a mix of FITs, generation-based incentives (GBIs), and tax breaks.

- The other Target Countries have set capacity goals for different RE technologies and each is at a different stage in the implementation of their support mechanisms.

**The deregulation of electricity markets can help spur renewable energy**

Deregulation allows customers their choice of electricity suppliers, thereby offering a wider range of options among power generation sources. This could be be especially relevant for increasing the uptake of renewable energy, by providing the right incentives to generators for catering to such customers.

**Feed-in tariffs**

Based on the graphical comparison of FITs (Figure 13) available across the Target Countries for wind and solar technologies (as the primary focus for "new" RE across this report), the following are our key observations:

- Unsurprisingly, the Target Countries with the highest levels of newly deployed RE capacity (i.e. China and India) now offer the lowest FITs, as a result of relative maturity and significant declines in project costs.

- For example, India's onshore wind FIT regime (established in 2003]) is credited with significant growth in capacity, increasing nearly ninefold in ten years from 2.1GW in 2003) to 18.4GW in 2014 (GWEC 2013).

- FITs also vary in-country (as shown by the high end of the range) depending on a number of factors, including:

    - Location of the project: Potentially encouraging projects in, for example, more remote or expensive locations.

    - Amount of local content used: Higher FITs may be awarded for projects that use locally produced technology, equipment manufacture, installation services, etc.

- Indonesia's most recent solar PV FIT (announced July 2016) is among the highest in the region, perhaps reflecting the stage of development of its emerging solar sector.

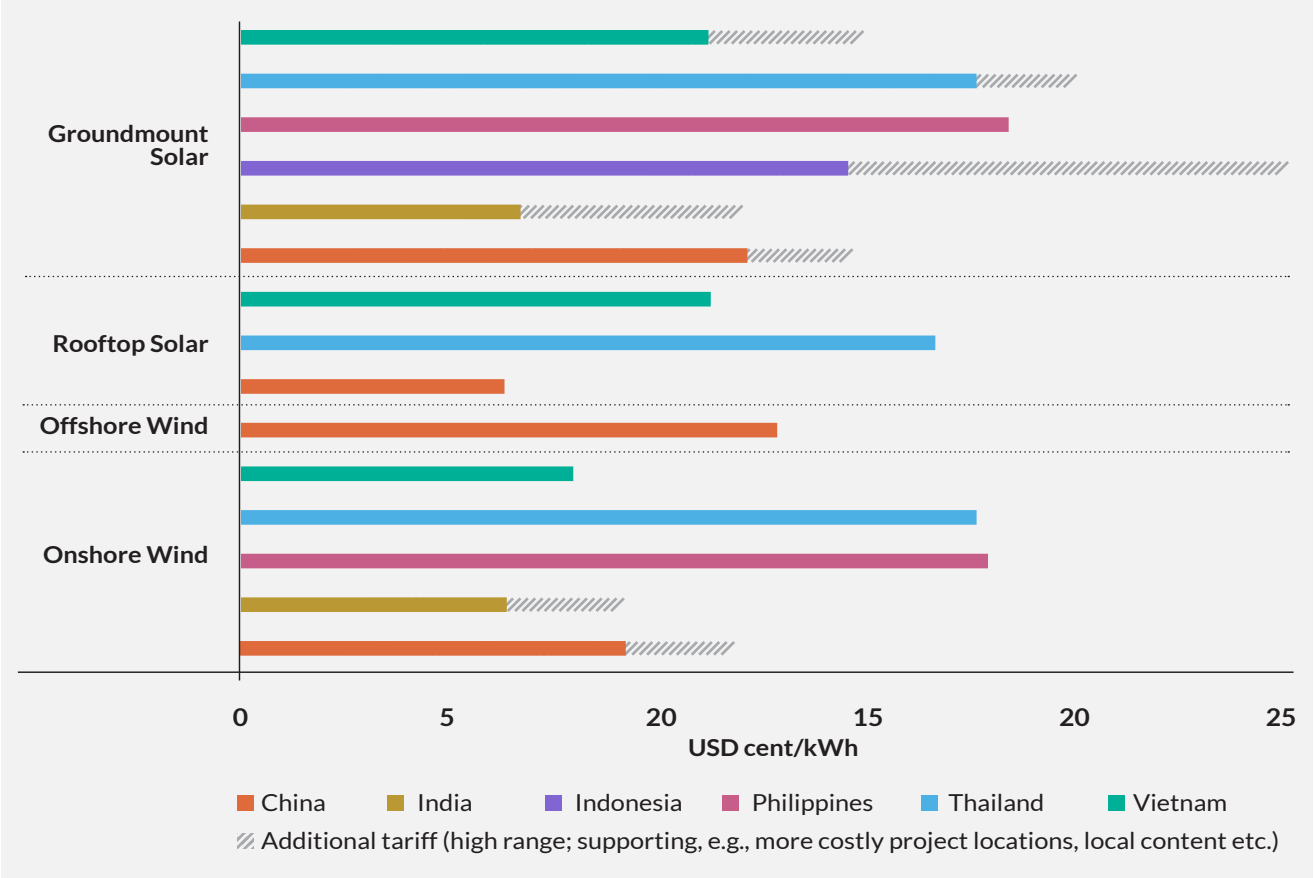
- China is currently the only country to have issued a FIT for offshore wind, which highlights the undeveloped nature of this technology in the Target Countries.

It is worth noting that while the initial tariff offered by the FIT is clearly an important driver of RE project development, other factors also play a significant role. These factors include the duration of the FIT payment, escalation provisions for indexation (which will be priced into the initial tariff rate), and timing of award (stage of project development) for the FIT.

For example, in the Philippines, a FIT will only be awarded once a project's construction is 80% complete (in practice, at the point of becoming grid connected), whereas in other Target Countries, FITs are typically awarded prior to construction commencement and securing financing. The latter is generally more attractive to developers as it gives them the ability to source bank debt during construction, something that is typically only available once the FIT has been agreed.

Figure 13, therefore, serves as an initial comparison only and should not be seen as a like-for-like analysis of the relative attractiveness of the FIT offered across the Target Countries.

Figure 13: FITs for solar and wind RE – by Target Country[2]




**Other supporting policies for incentivizing RE**

In addition to FITs, each of the Target Countries has introduced other supporting policies (Table 3), and some of the key features of these policies include:

- Tax incentives for RE development projects, whereby, rather than making specific budgeting provisions to support RE, governments forfeit tax revenues (see example in box on the right).

- Along with tax incentives, other key policy measures have included reverse auctions (which set out to procure a lower tariff through competitive procurement) and Renewable Energy Purchase Obligations (RPOs), which have been successfully implemented in some of the Target Countries (discussed later in the report).

**India: Encouraging RE growth through tax and generation incentives**

Tax incentives have been shown to encourage capacity deployment. For example, in India, the withdrawal of accelerated depreciation (AD), alongside GBIs in 2012/13 resulted in a fall of almost 50% in new RE capacity installations. As a result, the policies were reinstated in 2013–14 and capacity additions for that year exceeded the 2012–13 levels (MAKE, 2016).

- India has the largest range of supporting policies available, which have provided both national- and state-level institutions with the flexibility to support RE sector growth while targeting the most suitable technologies for certain locations and energy demand needs.

- One of the most recent and notable additions to India's policy mix has been the introduction of Viability Gap Funding (VGF) based reverse auctions with a fixed tariff. In these auctions, the Indian Government supports RE project construction through the payment of an up-front capital grant based on a pre-set tariff price (MNRE 2016).

2 The Government of the Philippines has recently proposed reduced FIT rates of US$0.16 cents/kWh (P7.66/kWh) for solar and US$ 0.15 cents/kWh (P6.97/kWh) for onshore wind. These rates have yet to be confirmed (Manila Bulletin 2016). Certain FITs shown above are benchmark tariffs published as a guide to reverse auction bidding. Therefore, actual tariffs achieved may be lower (e.g., India ground-mounted solar PV). In Vietnam, the solar FIT is currently under debate by the General Department of Energy and the UN Development Programme - US$ 0.15 cents / kWh is a maximum for mainland solar PV power plants, while US$ 0.19 cents / kWh is available for solar plants on islands. Vietnam's onshore wind FIT has been US$ 0.078 cents since 2011 but is also currently being revised to make it more favorable for developers (Wind Power Monthly 2016).

Bidders quoting the lowest VGF are selected, subject to their meeting predetermined technical requirements.

Table 3: Summary of other supporting RE policies (excluding FITs)

| | Reverse auctions | Tax breaks for RE | RPOs | Other support policies |
|---|---|---|---|---|
| China | Concession bidding available for onshore wind, solar and biomass sectors | Not currently available | Province-level RE goals | RE generation requirements at province and electricity generator level |
| India | Solar state auctions<br>Benchmark solar tariffs with VGF provided up-front based on a reverse auction process | 80% AD<br>10-year tax holiday<br>100% FDI permissible | State-level goals of 2%–14%<br>RPOs can be traded through Renewable Energy Certificates | Utility reform (incl. UDAY program) benefiting RE[3]<br>Solar parks: land and infrastructure provided/funded by the Government<br>Rooftop solar net metering – all states<br>GBIs for wind/solar (unless claim ADs) |
| Indonesia | Not currently available<br>In 2013, a reverse auction regulation for solar PV was enacted but with limited success and withdrawn alongside the solar FIT (following local manufacturers' challenge) | 30% net income tax reduction for 6 years<br>Free repatriation of investments, profits and dispute settlement<br>AD allowances<br>Loss carry forward for up to 10 years<br>Exemptions on VAT/import duties on goods | Not currently available | Established a geothermal fund facility worth US$380 million in 2012 |
| The Philippines | Not currently available | Income tax holidays for developers for first 7 years of operation<br>After this, lower corporate tax of 10% | Not currently available | Duty free import of RE machinery, etc.<br>RE identified as government priority investment area |
| Thailand | "Lucky draw" auction system implemented for solar systems of 5MW | No tax on large systems - 8 years<br>Followed by 15% tax - 5 years<br>Exemptions on RE equipment import | Not currently available | Not currently available |
| Vietnam | Not currently available | AD available for fixed assets<br>Exemptions on imports – 4 years<br>VAT exemptions | Not currently available | Not currently available |

3 The UDAY program addresses longstanding issues with the financial sustainability of certain Distributed Companies ('DISCOMS') in India, requiring state governments to relieve DISCOMs of large amounts of debt and allow for tariff revisions. While this program is not directly related to RE policy, a lack of such reform would be a clear obstacle to RE or any wider Independent power producer (IPP) development in the country.

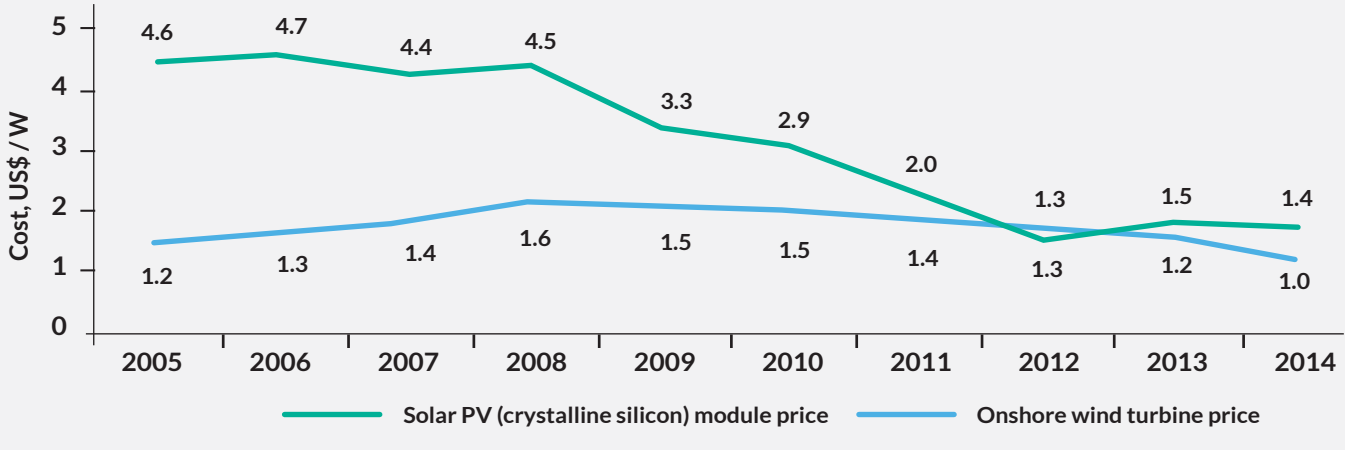
## 2. ECONOMIC: REDUCTIONS IN COST OF RE TECHNOLOGY

Globally, the cost of RE technology has witnessed a dramatic fall. Figure 14, tracks the changes in these costs from 2005 to 2014, highlighting the following:

- Onshore wind technology costs have decreased 13% from 2005 to 2014. There was an increase in these costs from 2005 to 2008, partly due to rises in the cost of primary commodities used in turbine manufacture, including steel and copper. However, since 2008, these costs have fallen 35%, maintaining wind's competitive cost advantage over solar PV modules.

- For solar PV modules, costs have decreased 70% over the same period, and have fallen further still in the past two years to as low as US$1.2 per MW (BNEF 2016), bringing solar PV technology ever closer to onshore wind's dominant position as the cheapest source of new RE.

Figure 14: Global RE cost trends – solar PV modules and onshore wind turbines




*Sources: Solar – BNEF 2016, wind – Wind Power monthly 2015*

The continual decline in technology costs is being driven by increasing RE deployment throughout the world, creating economies of scale in manufacturing processes, as well as advancements in the technology itself. The sizeable manufacturing bases in China and India for wind turbines (and solar panels in China) have contributed significantly to these reductions.

Table 4: Summary of solar and wind manufacturing capabilities in China and India

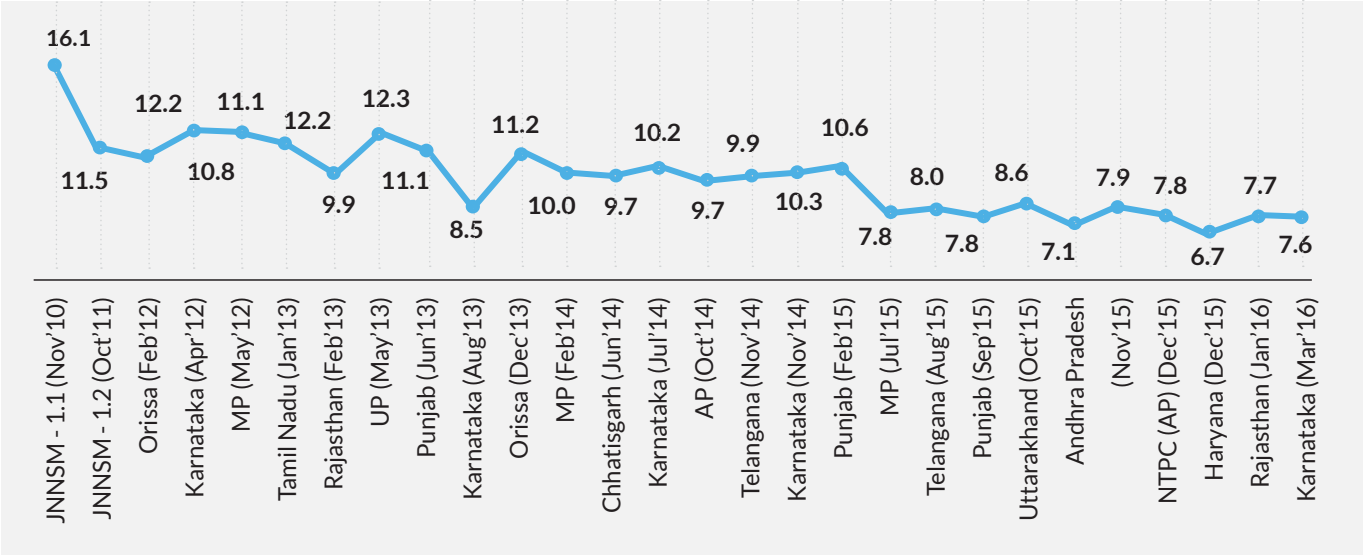
| | China | India |
|---|---|---|
| Wind | In 2015, Goldwind became the largest wind turbine manufacturer in the world by market share.<br>5 of the world's top-10 turbine manufacturers are Chinese (GWEC 2016). | Key exporter of wind turbines. One of the world's largest turbine manufacturing exporters, Suzlon, is located in India.<br>Markets include South America, the US, Europe, and Australia. |
| Solar | In 2014, Trina Solar became the top solar module supplier in the world by market share (IHS, 2015).<br>7 of the world's top-10 solar module suppliers are based in China (IHS, 2015). | (No major established solar manufacturing sector in India). |

**Falls in technology costs mirrored in auctions** / RE tariffs have fallen nearly as quickly through competitive auction processes as the decline in overall technology costs; for example, cost of solar PV modules fell 59% between 2010 to 2015, while tariffs fell 58% (comparing against the lowest tariff received in Rajasthan, or 53% if the March 2016 price is taken as the latest position) in solar auctions in India; see Figure 15.

As a result of downward cost trends alongside policy measures, leading Target Countries have experienced break-throughs in RE tariff costs.

For example, state solar auctions in India have achieved significant reductions in tariffs (>50%) in the past 6 years, falling below US$0.07 cents per kWh (Figure 15).

Figure 15: Solar state auctions – 2010 to 2016 (minimum bid tariff, US$ cents per kWh)




The lowest bid tariff in Rajasthan (US$0.067 cents per kWh) was achieved in part through government-allotted land with existing infrastructure being awarded to the winning bidder, as well as the location itself benefiting from some of the highest irradiation in the country.

It is important to note, though, that industry experts suggest that decision makers use caution with this kind of downward pricing as the squeeze on project returns could potentially hamper further development (PV magazine 2015).

Nevertheless, other Target Countries are ideally placed to benefit from substantial reductions in RE installation costs and efficiency improvements brought about by the massive adoption of wind and solar in China, India, and other countries across the globe.

## 3. RESOURCES: VAST UNTAPPED NATURAL RESOURCE POTENTIAL

Each of the Target Countries has considerable untapped RE resource potential (with a combined estimated total capacity, of over 6,000GW) as illustrated by the following table:

Table 5: Estimated RE resource across the Target Countries (potential capacity – GW, unless otherwise stated)

| Country | China | India | Indonesia | Philippines | Thailand | Vietnam |
|---|---|---|---|---|---|---|
| Wind | 700 (offshore) | 302 (onshore) / 1 (offshore) | 114 | 70 | 381 | 27 |
| Solar | 2,200 | 749 | 533 | 5.1 kWh/m$^2$/day | 23 | 13 |
| Geothermal | Unknown | Unknown | 30 | 4.5 | Unknown | 0.4 |
| Hydropower | 140 | 20 (target for SHP) | 75 | 13.1 | 0.7GW (SHP) | 7.2GW (SHP) |
| Bioenergy | 542 | Unknown | 33 | 4.5 | 200 (GWh) | 3 |
| Tidal | Unknown | Unknown | 18 | 170 | Unknown | Unknown |

*Sources: National Institute of Wind Energy 2016, IANS 2015, 4COffshore 2016, DSK Legal 2015, EBTKE 2016*

# Addressing the main challenges to scaling up RE (5 dimensions)

This section attempts to summarize the obstacles to further adoption and deployment of the RE technologies within the Target Countries, drawing insights from in-country experience and suggesting interventions that have proven effective in other markets. These are listed below in order of priority for policymakers.

## POLICY

### KEY BARRIER: ENSURING THE STRENGTH AND STABILITY OF AN RE REGULATORY FRAMEWORK

**Example**:

- Limited transparency around RE mechanisms can inhibit international investment. For example, in the Philippines, there has been some uncertainty around projects that did not make the latest solar FIT capacity quota, while in Indonesia, the timing of its upcoming FIT for onshore wind has yet to be confirmed.

**Experience sharing and suggested interventions:**

- Visibility and stability of RE frameworks are needed to attract long-term investors and lenders.
- Determining the appropriate starting FIT is a delicate exercise. The need to kick-start an industry with attractive returns must be balanced with the risk of creating an excessive financial burden on the public sector.
- Clarity on the frequency of FIT revisions and the overall cap eligible for FIT are required by the investment community to fully embrace a country's RE policy. Clarity is also essential for the avoidance of "stop-and-go" situations such as that experienced in the Philippines where investments in new projects virtually stopped for a period of nine months pending the new administration's renewal of the Renewable FIT that expired in March 2016 (a process that is still ongoing).
- In finalizing FIT regulation, governments may want to address the risk of delay or for the projects awarded. This will avoid pitfalls seen in other markets, like Japan, where a large portion of projects awarded under the original FIT were not built, but were instead traded to new owners at significant premiums. Restricting change of ownership (such that it is only allowed a number of years after the commercial operations date) with government consent further helps reduce this risk.
- As the market matures, governments may consider evaluating the appropriate timing for transitioning from FIT to reverse auction competitive tenders. Reverse auctions have proven extremely successful in India to quickly procure significant capacity and accelerate tariff reductions.
- Country-specific measures may also be required in countries where the creditworthiness of the RE procurement agent is not sufficient to attract long-term investment and financing. India successfully addressed the financial weakness of its various state electricity purchasers by having a creditworthy central government authority act as the purchaser of electricity for solar energy (which in turn is "re-sold" to the state utilities), thereby improving the risk profile for investors and lenders.
- Other options to address the financial weakness of a national utility include the creation of a "green fund" managed by the state and funded by contributions levied on consumers that would act as a backstop guarantor for utility payment obligations.
- For the benefit of potential foreign and domestic investors, the governments of the Target Countries should periodically update and disseminate policy statements, helping to maintain clarity and confidence in the policy environment by capturing changes as they occur.

- Setting up an independent regulator tasked with monitoring and advising the government on proactive measures for enhancing RE development would further help build market confidence and implement government strategies. For example, Indonesia's planned RE division of the state utility Perusahaan Listrik Negara (PLN) could play such a role in meeting the country's significant potential for RE.

## FINANCIAL

### KEY BARRIER: MAXIMIZING SOURCES OF FINANCING TO ENSURE THAT ACCESS TO CAPITAL IS NOT A CONSTRAINT TO THE DEPLOYMENT OF RE

**Examples:**

- Access to bank liquidity has, so far, not been a constraint to the deployment of RE in China or India, as these countries having historically relied on their deep domestic banking markets.

- While the banking market in China is equipped to support large state-owned enterprises, it is less accessible to smaller-scale developers. This is an issue seen across the Target Countries, where substantial upfront financing costs further impede access.

- In India, the domestic banking market is showing signs of over-exposure to the power sector, and the recycling of capital is required. In addition, the high cost of local debt and short term tenors available have led to the introduction of new forms of financing (such as green bonds).

- Thailand and the Philippines have relied on their domestic banking sectors. "Single borrower limits" (restricting the amount that can be leant to individual developers) are sometimes cited as a constraint by the banking sector in the Philippines.

- Power projects in Vietnam and Indonesia have historically been exclusively financed by international lenders that are not equipped to finance small-scale RE projects.

- Relying on a single source of financing could become an impediment to the widespread development of RE projects and to meeting the Target Countries' stretched goals.

**Experience sharing and suggested interventions:**

- The development of a domestic financing market may facilitate RE adoption and faster RE rollout of in Indonesia and Vietnam, notably for small-scale RE projects.

- Government stakeholders may investigate whether their current banking regulations prevent domestic lenders from extending long-term project finance loans.

- International organizations may conduct capacity-building sessions for domestic commercial banks to assist the setting up of project financing units.

- Government stakeholders and international organizations may study the creation of "green" development funds (e.g., Malaysian Green Technology Corporation, which works like a green investment bank) to provide financing solutions to small-scale developers, which are not served by the banking market. China and India are also promoting the development of a green bond market as an alternative to the banking market.

- India is addressing the over-exposure of its domestic banking market to the power sector through its UDAY program (financial reform of the distribution companies).

- Rules may be amended by some of the Target Countries so that local project developers can borrow money from international financial institutions or institutional investors.

- The securitization (only applicable for Target Countries with advanced financial markets) of existing operation projects may be considered, so that bank capital can be freed up for new projects.

### KEY BARRIER: DEALING WITH MACROECONOMIC UNCERTAINTIES

**Example:**

- Each of the Target Countries has risk associated with their currencies, interest rates, and inflation regimes.

**Experience sharing and suggested interventions:**

- An effective RE regulatory framework (e.g., FIT currency and indexation) needs to take into account the ability of investors to access long-term financing in the relevant currency and to deal with interest rate and inflation risks.
- The private sector often cites the introduction of inflation-indexed FIT/Power Purchase Agreements (PPAs) as a useful measure for further reducing and optimizing RE tariffs.
- Project developers and regulatory authorities in the Target Countries need to properly account for inflation risks during the feasibility stages to determine appropriate tariffs.
- Governments may offer to take all or a certain portion of the foreign exchange or interest rate risk, between the point of agreeing on the tariff and the financial close of the lending arrangements.
- India's currency guarantee fund is one such example of government intervention, using a currency forward contract with an overlay swap arrangement that allows local projects to borrow from international financial markets with no/minimal currency risk (IRENA 2016).

## ECONOMIC

### KEY BARRIER: DEALING WITH CUMBERSOME AND OPAQUE LAND ACQUISITION PROCESSES

**Example**:

- In most Target Countries, navigating relevant land acquisition rules has been time consuming and cumbersome at various stages of their RE sector development, limiting the ability of developers (especially international investors) to secure the necessary permits and approvals to move ahead with projects.

**Experience sharing and suggested interventions:**

- Simplifying land acquisition permitting requirements can boost investment in RE.
- Indonesia provides a useful benchmark in addressing investors' concerns as it has implemented Law 2/2012 on mandatory land acquisition and is spearheading the development of an inter-ministerial office to act as a "one-stop shop" interface for developers. This one-stop shop interface will help developers apply for and obtain all the permits and licenses required for power projects.
- A solution to the perennial land acquisition issues associated with large-scale RE projects could involve a government authority acquiring land in advance of a reverse auction mechanism or the leasing of government-owned land to developers.
- Central and state governments could work together to identify government-owned sites for suitable RE development and earmark these for RE use, especially for installations like solar rooftop panels.

### KEY BARRIER: FACILITATING MARKET REFORMS TO ALLOW THE "TRUE COST OF POWER" TO BE DETERMINED IN CONSUMER TARIFFS AND BENEFITING FROM FALLING COSTS OF RE

**Example**:

- In certain circumstances, falling costs are allowing RE to achieve grid parity with fossil fuels (e.g., in comparison to gas-fired generation), but not yet compared to coal-fired (given several Target Countries have abundant natural reserves).

**Experience sharing and suggested interventions:**

- Market reforms that allow the "true cost of power" to be determined and reflected by consumer tariffs may accelerate RE adoption. Internalizing the external costs of fossil fuel generation (such as local air pollution) would help to favor RE in investment decisions.

- Recognizing and promoting the need for private-sector transition from fossil fuels in order to avoid ownership of so-called "stranded assets," as rules around carbon emissions tighten over time, would further facilitate a clean energy transition.

- Also of prime importance to policy makers is focusing attention on ensuring that their country benefits from the falling costs of technology, which, according to the International Renewable Energy National Agency (IRENA) analysis, will depend increasingly on reducing the balance of system costs rather than the equipment itself (i.e., the inverters, racking and mounting systems, civil works, etc.), as well as the technology innovations and operations and maintenance costs associated with these areas.

## TECHNICAL

### KEY BARRIER: ANTICIPATING AND ADDRESSING CURTAILMENT CONSTRAINTS

**Examples:**

- In addition to setting ambitious goals of increasing RE capacity, it is equally critical to strengthen the ability to dispatch intermittent sources of power and avoid curtailment constraints to maximize the benefits of RE.

- RE curtailment is becoming a constraint in most markets, including China and India, as RE market share increases. It also leads to financial losses for RE project owners and investors.

- In China, the curtailment of RE sources is generally higher in winter due to obligations on power plants to dispatch energy and to meet annual quotas for minimum grid-dispatch hours. This results in the demotion of RE generation (and therefore payments) as supply tends to exceed demand.

- This is exacerbated by the slowing economy and the continued pipeline of new thermal generating capacity; as there is 20% or more overcapacity in the system, per country-wide estimates, with additional approved plants likely to increase this percentage further until 2020.

- In China curtailment is even higher in the Northern provinces (28-40% in some instances), resulting in ongoing discussions (such as 'Global Energy Internet') between Chinese electric companies regarding the interconnection of China, Korea, and Japan in an effort to solve a number of these curtailment issues (Institute of Electrical and Electronics Engineers 2015).

**Experience sharing and suggested interventions:**

- Adequate planning and implementation of investments into the grid system in markets with nascent wind and solar generation, such as the Philippines, Indonesia, Thailand, or Vietnam, would ensure that RE growth isn't stymied by integration and curtailment issues.

- Much of China's imbalance is expected to resolve in the coming years as the pipeline of new capacity is adjusted. However, in the near term, there will be negative impacts on the efficient use of renewables (even if projects are built and the generators paid). As a result, the costs to consumers will rise (because of excess investment), and the business environment for a sustainable renewables market will suffer, both in China and for Chinese exports of RE (which are potentially large).

- In addition to grid investment, an increased level of RE integration will require appropriate capacity building, software tools, and hardware to support system operations.

- As such, Target Countries should adopt contractual frameworks and grid dispatch policies that promote RE generation over and above installed capacity. For example, India rewards generation through GBIs which resulted in renewed investment in RE when they were re-introduced in 2013–14.

- This policy tool could be used in emerging RE sectors (such as in Thailand) where established baseload conventional generation may reach a point where supply exceeds demand and new RE capacity takes precedence over conventional generation in the dispatch order. Conventional can then be compensated through availability payments, rather than generation-based returns.

- This situation is less likely in countries like Indonesia and the Philippines, given that both of these countries have electrification rates of around 88%. With efficient RE generation planning and a robust grid policy, such as priority of dispatch, issues in these countries may be more easily avoided.

- RE can be promoted in the merit order of grid dispatch by prioritizing the setup of regional Renewable Energy Management Centers at the appropriate point where RE has become more established, along with continued investment and upgrades to physical grid infrastructure (e.g., through schemes such as India's Green Energy Corridor).

## RESOURCE

### KEY BARRIER: TAPPING LARGE RESOURCE POTENTIAL IN REMOTE LOCATIONS

**Example:**

- In China, curtailment has resulted from an imbalance between RE generation in resource-rich provinces that lack demand and the inability to transmit power to faraway, main load centers.

**Experience sharing and suggested interventions:**

- Location-specific FITs offer the flexibility to apply a standardized framework approach while reflecting the local costs of land acquisition, construction, and operation.

- Indonesia's Ministry of Energy and Mineral Resources takes this approach with their geothermal and solar FIT frameworks. China has also adopted this approach where provinces having lower resources provide an additional premium on the national FIT.

- FITs linked to project capacity may also be appropriate in certain countries, such as Indonesia and the Philippines, to ensure both utility-scale projects and smaller distributed energy projects are developed in remote off-grid locations, where RE is particularly suited to the archipelagic nature of these countries as an alternative to expensive diesel generation.

- In addition, in countries like Vietnam, Indonesia, and the Philippines, it may be more practical to focus on small-scale solar and wind in remote / island locations (where small turbine / PV systems are feasible), while concentrating hydropower and geothermal in mainland locations where power demand is high and land and RE resource potentially more accessible.

- Upgrading grid ancillary services, including associated market mechanisms, could enable inter-regional electricity transfer and improvements to the planning for RE generation.

# Closing the gap: Measures and strategies to scale up RE

## Attracting private-sector investment

To realize the significant investments required in meeting each Target Country's RE goals, governments and multilateral agencies alone do not have the required amounts of capital. Attracting new forms of private-sector capital and participation in RE projects is therefore critical.

This section explores the various measures available to increase private-sector interest, exploring the financial instruments available, the structuring and risk mitigation tools necessary to unlock this engagement, the involvement of the key private-sector stakeholders, the barriers to investment, and how these barriers may be overcome.

Ultimately, however, there remains the basic need on the part of the private sector for RE projects to be bankable and scalable across the Target Countries. It is therefore the responsibility of the government and international agencies to facilitate the development of suitable investment projects, through partnerships, capacity building, feasibility studies, and to prioritize the specific forms of RE most suitable to each country.

### AVAILABLE PRIVATE-SECTOR FINANCIAL INSTRUMENTS

Within some of the Target Countries, and elsewhere internationally, various financial instruments have been used to develop RE private-sector financing.

Table 6: Sources of private finance

**Institutional investors**

- These include pensions, insurance funds, sovereign wealth funds, and endowments. Typically, they provide a lower cost of capital than traditional bank lenders, through inflation-linked yields.
- They are insulated from equity market volatility and ideally placed to match their long-term liabilities (e.g., pension payments) with long-dated assets such as RE projects.
- It is estimated that US$2.8 trillion is available annually from pension funds and insurance companies (IRENA 2016).

For the Target Countries, mobilizing domestic institutional investors (e.g., local pension funds) would unlock significant new sources of capital. These could be invested directly into individual projects or financial instruments backed by pooled assets. For example, institutional investors can pool their capital into private yield companies (yield cos), offering long-term yield without exposure to equity market risk. This is particularly useful for investors who do not want the liquidity and exposure associated with public equity investments.

**Green bonds**

- These are bonds raised for the purpose of supporting "green" projects, and are seen as a new way for companies to tap into new sources of private and consumer finance.
- They enable companies to raise funds and to promote themselves as environmentally conscious.
- Despite being a rapidly growing funding source, the green bond market remains self-regulated; there are no set criteria that must be followed for a bond to be labelled "green".
- Banks (particularly in China) account for 21% of the US$121 billion green bonds raised to date.

The market for green bonds remains small relative to corporate bonds but could grow if governments offer tax incentives to the buyers of green bonds (as they do in the US).

**Yield companies**

- These are publicly listed and tradable companies set up by pre-established renewable energy developers, who place a portfolio of energy-generating (operational) assets under the governance of the yield co, which, in turn, raises capital and manages the assets to provide stable, long-term cash flows back to shareholders.
- In most cases, the original developer is one of the main shareholders of the yield co.
- Yield cos are popular in North America and Europe, having become a common form of financing for projects that, on the one hand, are low-risk for investors (since the yield co owns a portfolio of assets, rather than a single project) and, on the other, that help project developers access low-cost capital.
- It is worth noting that there may be limits to the appropriateness of a yield co structure for non-investment grade countries. In addition, the recent high-profile problems that have also affected SunEdison's yield cos (Terraform Power, primarily in the US, and Terraform Global which also covers some of the Target Countries) have led to questions around the sustainability of their business model due to the fact that they rely on investors, rather than commercial lenders, to conduct appropriate due diligence of the underlying assets generating their returns (Bloomberg 2015).

**Leasing (e.g., rooftop space)**

- For solar rooftop projects, building owners can lease their rooftops to developers who in turn install PV systems and sell the electricity to the building owner and/or utility companies.
- Developers benefit from any subsidies offered by governments and receive revenues from the electricity generated by their systems, while building owners receive leasing payments and pay the same or less for their electricity costs.
- In India, under the Gujarat India Solar Program, developers rent rooftops from building owners and sell the electricity generated to power utility companies using virtually no subsidies. This arrangement is promising as a sustainable business model, delivering benefits to each stakeholder, and has been replicated in other major cities across the country.

This form of private-sector financing is most suitable for distributed solar projects in the Target Countries, using business models already proven globally, but adapted for the local context. While investment returns are typically lower compared to when the systems are owned outright, the low up-front costs to developers can make leasing sufficiently attractive in some cases.

If supported by tax and other incentives, rooftop leasing has the potential to become a popular financing model, particularly in countries where the solar rooftop market is not currently well established (like Vietnam and Indonesia).

**Crowd and community funding**

- Popular in the West, crowdfunding platforms enable distributed project owners to obtain funding from a large pool of individual investors, each contributing a small amount of capital.
- Investors receive a constant annual rate of return for a fixed term before their principal is returned, while project owners pay slightly a higher interest rate for access to the aggregated capital.
- The difference between the amount that investors receive and the amount that project owners pay is collected as a premium by the crowdfunding company, similar to how lenders earn a spread on deposits issued as loans.
- Community funding is similar but confined to individual investors living in a particular locality (e.g. village or small town) that pool their capital together to invest in nearby RE projects.

Crowd- or community-funding could be attractive in the Target Countries if supported by the appropriate regulatory frameworks to enable individual investments to be pooled.

## PUBLIC SECTOR INVOLVEMENT TO ENABLE PRIVATE-SECTOR PARTICIPATION

To enable private-sector involvement in the RE sector, policymakers and government bodies must consider each of the following areas necessary to attract investment.

- **Supporting policies and regulatory frameworks:** There is a need to establish a robust, transparent framework and a clear set of procedures that investors and developers can follow to provide assurance that their project development activities will be rewarded with a PPA that meets their investment criteria.

- **Project structuring and de-risking:** Schemes such as initial funding for project feasibility studies, resource assessment, and technical assistance can encourage developers by relieving them of some of the more critical development risks. In addition, this process can help establish a robust set of project documentation that will facilitate the financing process further down the line. This is discussed in the next section.

### DESIGN OF RISK MITIGATION INSTRUMENTS

The identification of key risks and assistance in their mitigation are essential to encouraging private-sector participation in RE projects. Some of the key risks applicable to solar and wind projects are summarized in Figure 16.

Figure 16: Key risks for RE projects and supporting risk mitigation instruments

| | Example risk mitigation instruments |
|---|---|
| **1. Revenue** | |
| Resource | Insurance products |
| Offtaker default | Offtaker default guarantees |
| **2. Operational** | |
| Plant performance | Robust operations and maintenance (O&M) contracts |
| Grid/transmission | Standardized PPAs with clear risk allocation |
| **3. Financing** | |
| Interest rate | Hedging products and government-backed mechanisms |
| FX | Insurance products |
| | Offtaker default guarantees |
| **4. Macroeconomic** | |
| Regulatory change | Clear public communications |
| Indexation | PPA indexation provisions |

Governments and international agencies play a role in mitigating each of these risks.

**1. Revenue protection mechanisms**

- **Enhancing offtaker creditworthiness:** In most Target Countries, risk of offtaker default remains a key concern for investors. Government guarantees have helped secure financing of large-scale conventional power projects to date (e.g., Indonesia's Business Viability Guarantee Letters provide lenders and private-sector investors with an appropriate credit enhancement of PLN's payment obligations under the PPA), and the same approach could be similarly applied to utility-scale RE in the Target Countries.

- **Insurance products** are increasingly available and have been deployed in developing markets to cover resource risk (e.g., geothermal resource risk, solar irradiation shortfalls) as well as other revenue-related risks.

- A similar approach could be adopted by those Target Countries where the financial strength of the electricity offtaker is currently a key investment barrier. This can provide additional security and guarantees over both PPA payment and the risk of termination.

**2. Operational risks**

- **Managing plant performance through robust O&M provisions:** Establishing guideline performance ratios and template O&M agreements, alongside encouraging the pooling of O&M services across several projects could help reduce costs and develop a local market for O&M service providers.

- **Standardizing PPAs with consistent grid dispatch risk provisions:** Providing clear terms around the circumstances related to offtaker non-acceptance of plant output can help financiers get comfortable with local grid issues. Developing and assisting local technical consultancy competencies to assist developers and investors in assessing curtailment risks could further help reduce the cost of capital requirements over time.

**3. Financing risks**

- Enabling a market for interest rate hedging mechanisms can help provide investors with certainty over the all-in costs of financing. However, this also eliminates the need for them to build in contingencies to project costs, and may reduce an RE project's local competitiveness.

- Foreign exchange conversion: without establishing a domestic currency-lending market, international lenders will require US dollar denominated or hedged PPA payments; in countries such as Vietnam to date, lenders have not been comfortable with US dollar-linked local currency PPA payments that must be converted on the date of payment. Measures to address this issue include:

    - Mechanisms such as currency hedging instruments and guarantee funds could simultaneously address this issue and the issue of the high costs associated with hedging instruments.

    - Reverse auction bid tariffs could be adjusted for FX rate movements between the bid date and the financial close with the government covering up for the costs, thereby providing bidders with some pricing certainty at bid submission stage.

**4. Macroeconomic risks**

- **Clear, transparent public policies:** Assist developers in understanding the likelihood of future changes to project returns, helping them meet investment decisions.

    - It is critical to demonstrate a consistent approach to tariff changes (e.g., annual reductions in line with technology costs) to give developers certainty on timing.

    - "Grandfathering" (i.e., guaranteeing historically awarded tariffs) provides investors with certainty over long-term project returns, eliminating the need for them to "price in" these risks with a higher tariff.

- **PPA indexation provisions**: Enable bidders to offset potential cost indexation through matching (partially or fully) with an indexing PPA tariff.

    - For example, under South Africa's RE IPP Procurement Program, bidders must propose both fully and partially indexed prices. Doing so enables the Government to assess which offer has the best value for money from a hedged inflation perspective (a trade-off between lower up-front tariffs but with higher inflation assumptions, or vice versa).

# Regional cooperation between the Target Countries

Target Countries may actively collaborate to share knowledge and technical resources, to encourage the adoption of "best-practice" RE procurement techniques.

**Example: Capacity building in RE procurement**

While each country has its own unique challenges to address in this regard, there are several key best practices that can be shared from among the Target Countries to support the procurement of cost-competitive RE.

India presents many examples for the other Target Countries to follow when it comes to designing such a process, with successes such as those outlined below, resulting in increased international investor participation in its state solar auctions and some of the lowest global tariffs seen:

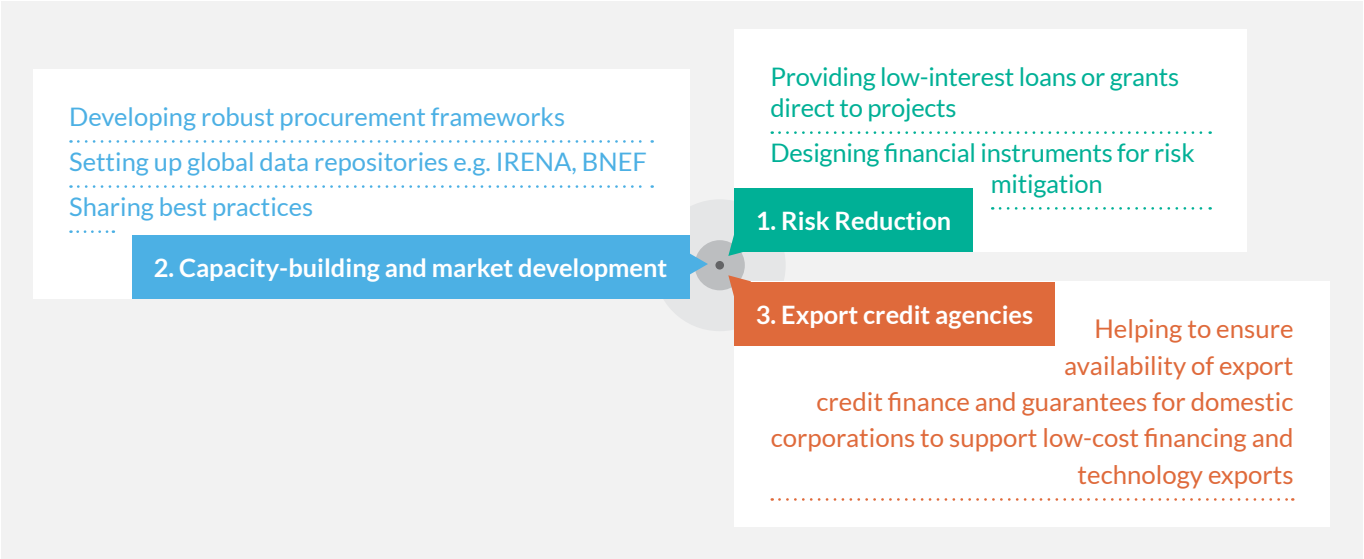
- Providing government land where available gives developers immediate certainty over land availability and avoids lengthy land rights and approval procedures (for example in Rajasthan (India), where the lowest tariff bid was received to date).
- Setting timely bid windows (for each state solar auction) so that developers can prepare well in advance.
- Using a transparent evaluation methodology wherever possible to encourage consistent, comparable bidding, and providing investors with certainty over their bid's evaluation.
- Establishing consistent project documentation and a standardized procurement framework to speed up the procurement process.

These are some examples of best practices that can be shared and further discussed as part of the detailed dialogue.

## ROLE OF INTERNATIONAL AGENCIES

There are a number of key financial and other supporting roles (Figure 17) that international institutions can play in facilitating investment across the Target Countries.

Figure 17: Principal roles of international institutions




**1. Risk Reduction**

To date, limited funding options have been available for RE projects in most Target Countries, constraining the scale of RE development. While most funding has come from commercial lenders, the amount of capital available from these private sources is limited. For this reason, the cooperation of multilateral development banks in helping the Target

Countries mobilize international climate finance is critical to accelerating the further deployment of RE. This can take the form of low-interest loans, grants, or blended loans to middle-income and developing countries for the demonstration, deployment, and transfer of low-carbon technologies.

In addition, there remains significant potential for designing financing models that can draw in different sources of capital, as the sophistication of financial instruments is yet to develop. Innovative financing models are needed both for reducing risk and for achieving scale. Particular challenges that could be addressed by such instruments include risks associated with project development, the level of which depends on a variety of factors, such as the creditworthiness of the offtaker, foreign exchange rates, interest rate volatility, and inflation. This is where innovative instruments could substantially help in increasing the bankability of RE projects.

**2. Capacity building and market development**

**Supporting domestic financing markets:** International agencies have a role to play in assisting governments with the design and planning of effective on-lending facilities tailored to the specific context of the country. Other actions that can help build this market locally among the Target Countries include: identifying pilot programs; working with local financial institutions to build skills and capabilities; and providing resources and technical knowledge.

**Project screening:** International institutions can help in identifying and selecting suitable projects and locations by contributing at the feasibility study stage and throughout the procurement design phase through project tendering.

**RE tendering:** As RE becomes more established and the Target Countries move further toward a reverse auction procurement processes, the design of a robust evaluation framework and procurement strategy will be essential to attracting credible international participation. In this area, India's energy procurement programs provide a useful reference point for the other Target Countries.

**3. Export credit agencies**

Export credit agencies (ECAs) can help to supply government-backed loans, guarantees, and insurance products to domestic corporations, enabling them to export products (typically technology) to the Target Countries.

- Guarantees can help mitigate political, policy, regulatory, credit, and technology investment risks. Though their use has been limited. In a survey conducted in 2014, only around 4% of total infrastructure risk mitigation issuances were for RE by value (IRENA 2016).

- These products can, however, help technology providers without a proven track record or those with weak credit status. For example, they could help facilitate the introduction of new RE technologies, such as low wind speed turbines, into Target Country markets.

- In addition, ECAs can help guarantee offtaker risks in some circumstances, supporting government guarantees and wider government measures to enhance the creditworthiness of state utilities.

ECAs overall involvement in a project can help to mitigate the perceived risks to local lenders through international involvement and a certain level of due diligence conducted in the course of project development, in turn, helping the sponsor to secure affordable local funding at longer debt tenors than may otherwise be possible.

## Where next for RE? Maximizing off-grid and energy storage potential

### REALIZING THE ADVANTAGES OF OFF-GRID RE

South East Asia possesses one of the lowest electrification rates with approximately 20% of its 625 million population living outside of the national grid (Püttgen 2016). Adding to this are the geographical challenges that countries face. Both Indonesia and the Philippines have widely dispersed populations across more than 17,000 / 7,000 islands respectively, while 44% of Chinese nationals and 67% of people in India live in rural areas with limited power access (The World Bank 2016).

Off-grid storage solutions are therefore highly relevant to the remote and rural areas within the Target Countries. IRENA's research has shown that RE technologies are gradually becoming cheaper and are now the most financially viable option for off-grid energy solutions in many rural areas. Moreover, these technologies are markedly less expensive and cleaner compared to the traditional kerosene- or diesel-based energy generation alternatives (IRENA 2014).

This presents governments and other stakeholders with a vast opportunity to capitalize on the significant potential for off-grid RE. However, key challenges will need to be overcome:

**Financing issues for off-grid energy solutions**

- A large amount of initial capital expenditure is required to develop off-grid energy facilities, in addition to high ongoing running costs.
- Sources of finance to take on these projects are highly limited as most enterprises involved in the sector are nascent and have not built up the strong credit histories necessary for obtaining significant debt funding.
- Equity investors tend to demand a high level of return that is not always in line with the expectations of their underlying investments.
- Therefore, off-grid solution projects are not likely to experience financial viability or wide-scale deployment until they have been established for a reasonable length of time.

**Possible interventions to accelerate off-grid deployment**

- Innovative financing mechanisms such as the 'first-loss guarantee', concessional debt, and capital guarantees, can be made available to enterprises to quell the funding issue.
- All subsidy benefits available to off-grid projects and the associated application processes should be made clear so that firms will be encouraged to invest.
- An open debate with enterprises in the sector will aid policy-setting and help to remove uncertainties and best serve the interests of all stakeholders. Cost and revenue estimates can be regularly revised with the help of industry experts to enable investors to conduct a more robust analysis.
- Governments should conduct more surveys of households without access to electricity and publish the data to allow stakeholders to make more informed decisions.

## ENERGY STORAGE SET TO TAKE CENTER STAGE

Energy storage is a crucial technology with the potential to redefine the power generation and transmission landscape through its ability to accumulate energy and release it, meeting demand when required, thereby preventing curtailment.

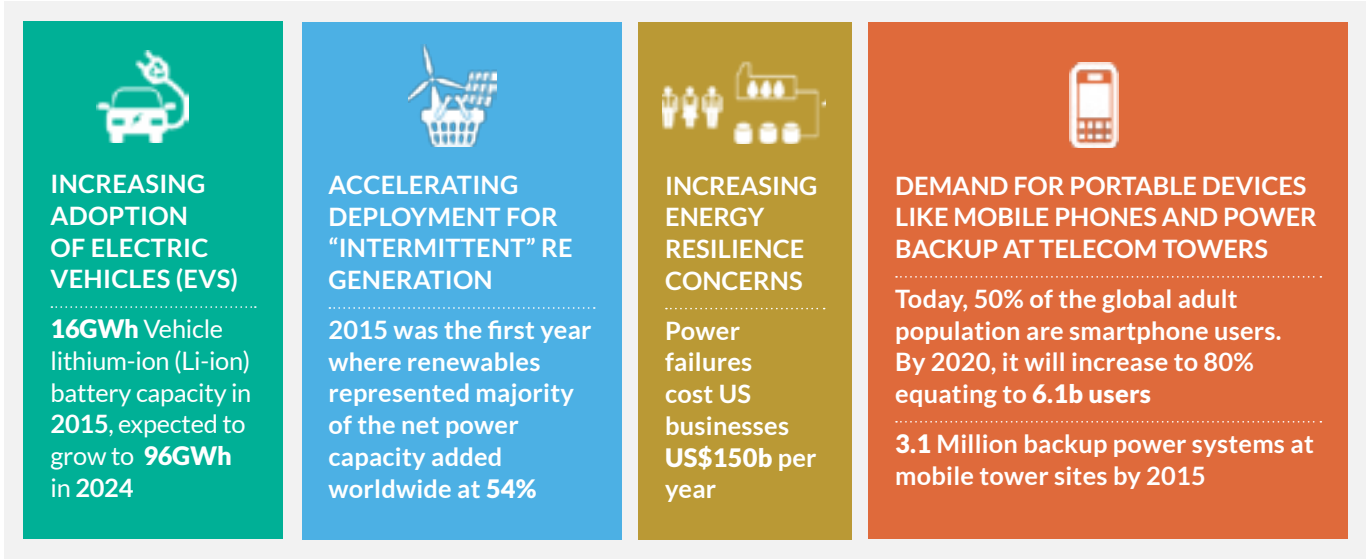
Energy storage systems (ESS) offer a unique solution to the shortcomings of transmission and distribution systems by managing power supply in a more efficient manner (placing generation and storage closer to the site of consumption) while also enabling increased energy access through off-grid storage solutions combined with small-scale generation.

A discussion on enhancing RE investment would, therefore, not be complete without assessing the game-changing role that ESS is expected to have in the near future.

**China: Energy Storage is critical to addressing curtailment**
In China, RE has not been integrated as efficiently into the grid as envisaged, with some curtailment (restrictions) on plant outputs to avoid grid instability (e.g., where demand does not match supply). Advancements in energy storage technology could provide a technical solution to curtailment.

Although some forms of ESS have been in use for decades (such as batteries and pumped hydroelectric storage), the transformation of technology in recent years has raised new macro trends in the applications of ESS, explaining the growth of the ESS market (Figure 18).

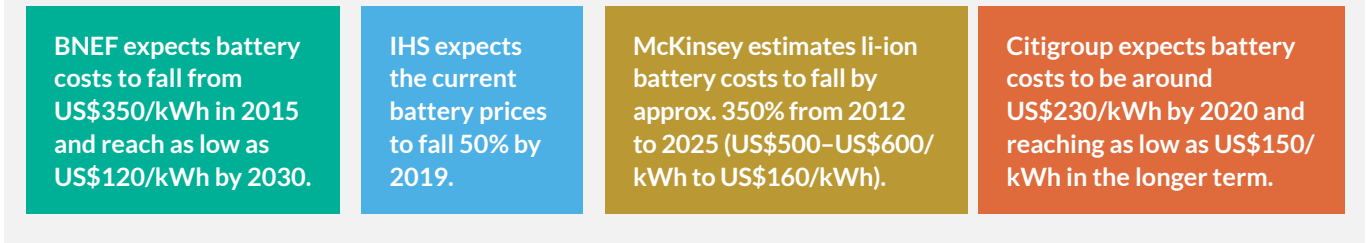
Figure 18: Macro trends driving the ESS market




Although pumped hydroelectric storage (PHS) dominates the storage landscape with over 99% usage, recent application has been limited due to vast geographic constraints. Apart from PHS, lithium-ion (Li-ion) batteries have become the most widely adopted technology, representing over a third of global ESS capacity, due to their high energy density, efficiency and life cycle.

Power and utilities stakeholders are now leveraging this experience and technological advancement, adopting Li-ion batteries for use in the power sector. Although there is no consensus on specific price forecasts for battery technology, there is a unanimous agreement that prices will continue to decline 50%–100% by 2020 (Figure 19). This trend reflects that these technologies hold significant disruptive potential in the energy storage landscape in the near future.

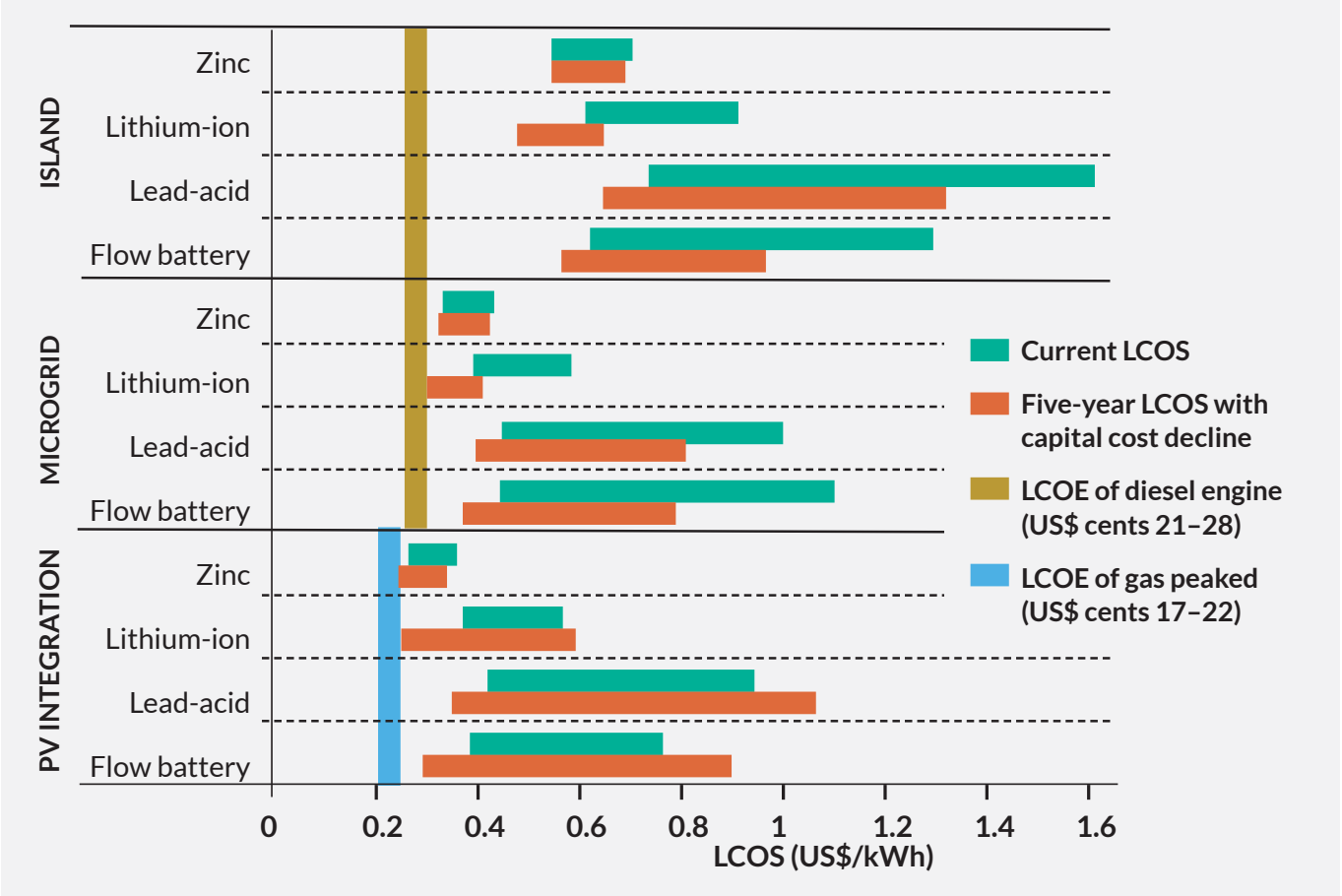
Figure 19: Battery cost forecasts




*Sources: Citigroup 2015, IHS 2015, BNEF 2016, McKinsey & Company 2012*

Lazard has forecast the levelized cost of storage (LCOS) — a measure of the cost of battery technologies — taking into account installation cost, project life and levelized returns. The analysis below (Figure 20) compares the LCOS of various battery technologies; although the capital costs of batteries are forecast to decline, they are not expected to hit "grid parity" with conventional generation sources by 2020, though Li-ion and zinc get closest (at the low end).

Figure 20: Current and forecast LCOS




*Source: Lazard Ltd 2015*

The pace of development and deployment of new chemistries is accelerating, and could play an important role in grid stabilization and in reducing the curtailment of RE (as seen to an extent in the more established Chinese and Indian RE markets). It also offers an increased scope for remote island deployment in archipelagic nations (e.g., the Philippines and Indonesia) and rural off-grid electrification (e.g., in Vietnam and Thailand).

As the technology matures, Target Country governments need to plan forward, considering policies that will promote RE and cost-effective ESS deployment while ensuring integration with the grid infrastructure.

The effectiveness of policies implemented to date around the globe vary significantly, from Japan's US$98 million subsidy package to cover up to 67% cost of Li-ion battery systems to Germany's state-owned bank KfW providing low interest rate loans for solar plus ESS.

Energy storage is likely to become a key consideration in determining each Target Country's energy future, whether it takes the form of:

- a merchant resource, helping residential consumers save against retail tariffs or even participating in energy trading through peak price arbitrage,
- large-scale deployment, used by corporations and utilities to arbitrage wholesale power prices, or
- distributed grid integration, ensuring energy supply security and balancing supply and demand more effectively while reducing the curtailment of intermittent RE sources.

**India: EVs and solar PV tenders**
With an objective of becoming a 100% EV nation by 2030, India is developing a scheme to make EVs affordable by introducing a zero down payment arrangement. This could potentially kick-start the emerging energy storage sector.

India has announced plans for an upcoming trial program to include ESS in their state-run solar PV tenders.

The extent of this disruption will depend on the enabling policies that will drive private-sector participation and help reduce in-country costs of ESS over time.

## Conclusions: Selecting the right policy tools

Increasing the deployment of RE in the Target Countries (particularly those with nascent RE markets) could provide considerable economic, environmental, and social benefits as outlined earlier in the report.

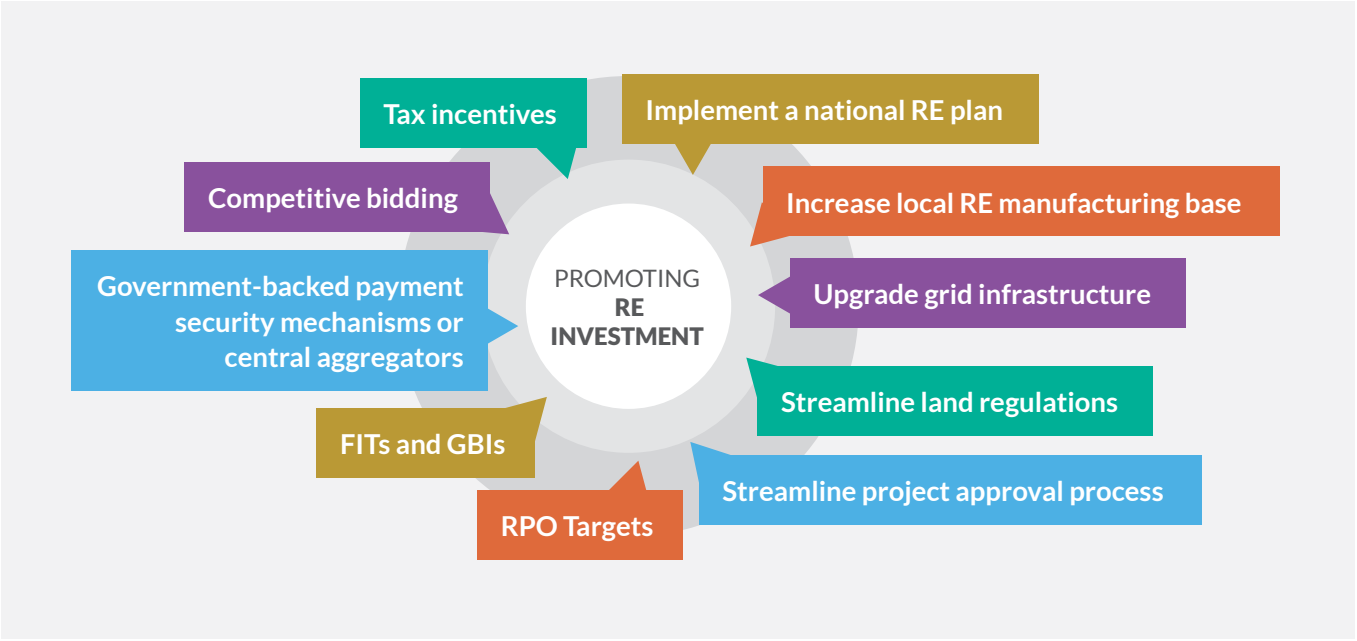
In those Target Countries identified as leaders in the RE sector (namely, China and India), RE has made great strides in recent years with government policies and national goals paving the way for significant growth, particularly in the solar and onshore wind sectors. To unlock the next phase of growth, however, all Target Countries must look at new ways of enhancing private-sector participation in their respective RE markets.

Governments and their energy ministries must work together to scale up RE investment. As the scale and scope of individual energy ministries alone is often limited and can create coordination issues among different ministries (e.g. planning, land permitting, infrastructure development, environmental management, and climate change as well as finance), each needs to bring together its expertise, resources, and policies, in order to facilitate the development of a supportive policy framework.

This process must be supported by international agencies providing robustly tested, best practice methodologies and key learnings.

Some of the key policy tools available to the Target Country governments are highlighted in Figure 21, providing a helpful resource for stimulating consideration and discussion among this report's audience and for assisting the Target Countries in choosing the most suitable policy tools and designating appropriate levels of priority, depending on the cost, ease of implementation, and relative effectiveness of each.

Figure 21: Summary of policy measures to promote RE investment in the Target Countries



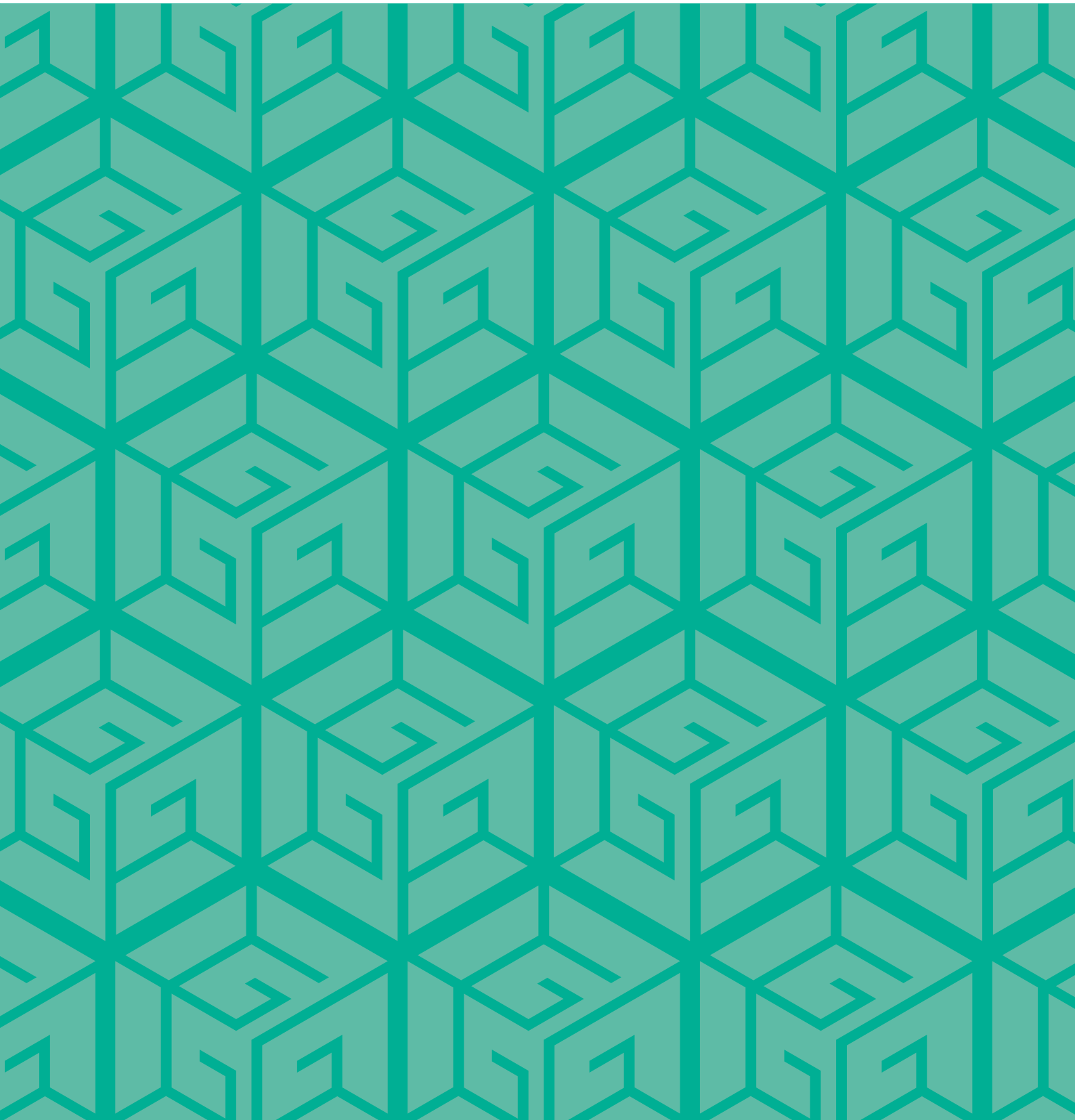

**Key action points**

While deciding among the various policy tools available, governments can prioritize the following action points to enhance the attractiveness of their national RE sectors:

- Prioritize investment in the grid network in parallel with RE policy measures to ensure capability of managing increasing penetration of intermittent generation sources and reduce the risk of curtailment
- Manage robust market mechanisms for supporting RE, including setting transparent government policies with clear time frames for investors to follow to ensure their eligibility
- Accelerate private-sector financing in RE through the development of various financial instruments

- Recognize the cost competitiveness of RE over time and adjust policy tools to reflect this
- Measure the external benefits of RE generation in decision making
- Facilitate project structuring and mitigation of in-country risks to enhance attractiveness of RE project investment to developers

In summary, as the Target Countries seek to increase their electricity access to meet future demand, furthering the deployment of secure, affordable, low-carbon energy should be a priority. This can be accomplished by placing cost-effective, flexible, and scalable RE at the center of their policy-setting processes. Moreover, doing so will help to meet the objectives of all energy sector stakeholders, both at the national and international levels.



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