



CLIMATE  
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# Blended Finance in Clean Energy: Experiences and Opportunities

*Annexes*

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## 1. Annex 1: High impact investment opportunities and barriers

### 1.1 Methodology for country selection

We identified potential markets for high impact investment opportunities requiring blended finance support by looking across 140 developing economies, and identifying those that are not classified as investment grade, which however score well in terms of being the most attractive for private sector investment, and reach at least 500 MW in projected untapped capacity for renewable energy sectors.

We then ranked the 46 meeting the abovementioned criteria by their energy access and climate change relevance scores, indicative of the marginal impact that a dollar invested in such countries in clean technologies would have in increasing the quality of energy access and addressing climate change. More specifically:

- **Investment grade** countries were considered as those scoring **60** or more on the Trading Economics index;<sup>1</sup>
- **Projected untapped capacity** was estimated considering current deployment vis-à-vis planned deployment and country targets by 2030 (BNEF<sup>2</sup>, PLATTS World Electric Power Plant Database,<sup>3</sup> REN21<sup>4</sup> and IRENA). Renewable energy sectors considered included Solar, Wind, Hydro, Geothermal, Biomass, and Tidal energy;
- The minimum level of attractiveness for the private sector was set to **0.5** of the **private sector score**; while the aggregate final impact of investment was estimated by combining **climate relevance** and **energy access relevance scores**.

Estimates of the **private sector**, **energy access relevance** and **climate change relevance scores** were based on a set of sub-indicators, in turn relying on a set of 23 raw data sources, as illustrated in Table A1 below.

**Table A1: Data sources**

Score	Sub-indicator	Raw Data
Private sector score	Market potential	Market Size (WB)
		Market Growth (IMF)
	Access of foreign investment	Foreign Direct Investment (WB)
	Access of private investment	Investment in energy with private participation (WB)
	Access to affordable credit	Access to credit (WB)
		Attractiveness of interest rates (WB)
Loan repayment risk (attractiveness of)	Risk premium on lending (WB)	

<sup>1</sup> Trading Economics Index – Credit Rating. Accessed October 2017. <https://tradingeconomics.com/country-list/rating>

<sup>2</sup> Bloomberg New Energy Finance Database. Accessed October 2017. <https://www.bnef.com/core/market-size?tab=Capacity>

<sup>3</sup> S&P Global Platts World Electric Power Plants Database, June 2017, Accessed October 2017. <https://www.platts.com/products/world-electric-power-plants-database>

<sup>4</sup> REN21. 2017. "Renewables 2017: Global Status Report." [http://www.ren21.net/wp-content/uploads/2017/06/17-8399\\_GSR\\_2017\\_Full\\_Report\\_0621\\_Opt.pdf](http://www.ren21.net/wp-content/uploads/2017/06/17-8399_GSR_2017_Full_Report_0621_Opt.pdf)

	Country risk (attractiveness of)	Credit rating (TE)
		Country Risk (OECD)
	Currency risk (attractiveness of)	Currency stability (WB, OANDA, IMF)
		Currency appreciation (WB, OANDA, IMF)
	Inflation stability	Consumers' inflation stability (WB)
	Lending inflation stability (WB)	
	Ease of doing business	Ease of doing business (WB)
Energy access relevance score	Population w/o Access to Electricity	Access to electricity (WB)
	Electricity Prices	Residential electricity prices (IEA, Climatescope)
		Industrial electricity prices (IEA, Climatescope)
Electricity consumption growth	Electricity consumption growth (EIA)	
Climate change relevance score	Energy Intensity	Energy intensity level of primary energy (WB)
	CO2 emissions intensity	CO2 energy intensity (WB)
		Grid emission factor (IGES)
	Supporting environment for climate change	Enabling Framework for Climate Change (Climatescope)
GHG management (Climatescope)		

Sources: EIA international energy statistics,<sup>5</sup> WB database,<sup>6</sup> IMF World Economic Outlook Database,<sup>7</sup> IGES List of Grid Emission Factors,<sup>8</sup> Climatescope,<sup>9</sup> TE Trading Economics Credit Ratings,<sup>10</sup> OECD Country Risk,<sup>11</sup> OANDA,<sup>12</sup> IEA - Energy Prices and Taxes.<sup>13</sup>

When calculating and aggregating together individual raw data and sub-indicators we factored in the structures of their distributions, as well as their availability. More specifically, individual raw data and sub-indicators were:

- Rescaled to a one-unit range, shifting their distribution to a median of 0 to offset the impact of a distribution skewness and make them more comparable between each other.<sup>14</sup>
- Weighted by their availability in the developing country sample as a measure of their quality / reliability<sup>15</sup>

<sup>5</sup> Energy Information Administration – International Beta. Accessed October 2017.

<https://www.eia.gov/beta/international/>

<sup>6</sup> World Bank – DataBank. Accessed October 2017. <http://databank.worldbank.org/data>

<sup>7</sup> World Economic Outlook Database. Accessed October 2017.

<http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx>

<sup>8</sup> Rocamora, A. and A. Amellina. 2017. "List of Grid Emission Factors." Institute for Global Environmental Strategies. <https://pub.iges.or.jp/pub/iges-list-grid-emission-factors>

<sup>9</sup> Climatescope. Accessed October 2017. <http://global-climatescope.org/en/>

<sup>10</sup> Trading Economics Index – Credit Rating.

<sup>11</sup> OECD – Country Risk Classifications of the Participants to the Arrangement on Officially Supported Export Credits. Accessed October 2017. <http://www.oecd.org/tad/xcred/cre-crc-current-english.pdf>

<sup>12</sup> OANDA. Accessed October 2017. <https://www.oanda.com/>

<sup>13</sup> OECD. 2017. "Energy Prices and Taxes." Vol. 2017, Issue 3.

[http://dx.doi.org/10.1787/energy\\_tax-v2017-3-en](http://dx.doi.org/10.1787/energy_tax-v2017-3-en)

<sup>14</sup> A distribution – even if rescaled – may have a higher median than another. This would give this distribution a higher weight when adding indicators together. Hence the correction by subtracting the 50<sup>th</sup> percentile from rescaled values.

<sup>15</sup> Indicators relying on more comprehensive data sets are given greater weights.

The two steps above can be summarized by the following equation:

$$Rescaled(x) = \left[ \frac{x - \min(X)}{\max(X) - \min(X)} - \tilde{x}(X) \right] \times f(X)$$

Where  $X$  is the raw data / sub-indicator series,  $x$  is the individual country raw data / sub-indicator,  $\tilde{x}$  is the median (or 50<sup>th</sup> percentile), and  $f$  is the frequency (or availability).

Minimum availability of data was also considered to finalize the list of countries when building each score, excluding scores covered by less than 65% of sub-indicators.

The final aggregated scores were then rescaled and presented as a [0,1] intervals to improve the readability of indicators.

### Notes on methodology

- **We acknowledge that some stakeholders may adopt other criteria in ranking economies, favoring absolute economy-wide impacts to relative impacts.** When ranking countries according to the potential impact they have on energy access and climate change we looked at relative data (e.g. emission intensity, or % of people without energy access), rather than absolute data (e.g. total emissions, number of people without access). We assumed that the former would be better representative of the marginal impact of a dollar invested – and thus of the interest of investing – while we considered the latter approach as biased by the size of the economy, which we already considered as one of the raw data defining private sector attractiveness.
- **Changing the weight of scores and sub-indicators could have an impact on final results.** When building final scores, we made no qualitative judgement on which sub-indicator or raw data can be considered more or less important other than the selection of the data composition of each indicator. We considered all data as equally important, distinguishing between one and the other only based on its availability at country-level in relation to each indicator. Similarly, when ranking countries according to the potential impact they have on energy access and climate change, we considered both scores as equally important in defining potential impact.

#### 1.1.1 LIST OF SELECTED COUNTRIES PER METHODOLOGY

The following table illustrates the result of our country selection process. We grouped countries in different tiers of 8 countries each, according to the magnitude of their energy access and climate relevance aggregate scores. The countries selected for the in-depth analysis (see following paragraph 1.3) belong to the first tier.

Tier 1 countries	Tier 2 countries	Tier 3 countries
Mongolia	Namibia	Guyana
Rwanda	Kyrgyz Republic	Serbia
Cambodia	Zambia	Algeria
Mozambique	Bosnia and Herzegovina	Guatemala
Uganda	Jordan	Nicaragua
Kenya	Lao PDR	Cote d'Ivoire
India	Honduras	Indonesia
South Africa	Bangladesh	Brazil

The following table illustrates the tier 1 countries ranking, based on individual ranking criteria.

Tier 1 countries if based on energy access relevance score only	Tier 1 countries if based on climate change relevance score only
Cambodia	Mongolia
Rwanda	South Africa
Uganda	Bosnia and Herzegovina
Kenya	Serbia
Mozambique	India
Zambia	Kyrgyz Republic
Namibia	Libya
Lao PDR	Jordan

## 1.2 Methodology for investment opportunity estimate

We calculated the investment opportunity for the countries identified by applying regional or country specific capital costs of technologies to the planned and targeted capacity in megawatts (MW). Country-specific figures from BNEF (2015) were used to estimate average capital costs of each technology per MW installed, or regional figures from REN21 (2017) when

country specific data were unavailable. REN21 figures were also used to determine maximum and minimum range values.

Details on values used for the specific estimate in this report are outlined within country summaries in paragraph 1.3 of this Annex.

### Note on methodology

We chose in this report to include both large hydropower (e.g., defined in this report as installations >20 MW, though the threshold ranges from 10-50 MW) and small hydropower (<20MW), as, from a climate change perspective, hydropower regardless of installation size has greenhouse gas emissions benefits, and private sector investors have the opportunity to participate in both small and large installations. However, there are important debates regarding the social and environmental impacts of large hydropower, and many renewable energy market participants exclude large hydropower from their definitions of “clean energy.” Therefore, below we include available data on planned hydropower installations, broken out by size. The vast majority of planned hydropower capacity is for large installations.

Country	Total Planned Hydro Capacity (MW)	Small hydro (%)	Large hydro (%)
India	106392	4%	96%
South Africa	1618	6%	94%
Mozambique	5045	0%	100%
Cambodia	2189	2%	98%
Mongolia	412	7%	93%
Kenya	466	23%	77%
Uganda	2138	9%	91%
Rwanda	129	37%	63%

## 1.3 Overview of high impact regions and markets

### 1.3.1 SOUTH ASIA

In South Asia, India is a country with great potential both in decarbonization and electrification, combined with the possibilities of a large economy. Major cities suffer from pollution as a result of fossil fuel based electricity generation, and meanwhile 244 million people lack reliable access to electricity. The country has established ambitious renewable energy targets including in the solar PV, wind, biomass, and small-hydro sectors, and \$48.3bn has been invested in clean energy from 2011-15. However, major barriers still exist in terms of renewable policy sustainability issues as well as financial access restrictions.

Bangladesh, with the highest population density in the world, has limited capacity to expand on-grid utility-scale renewables given land constraints, but is the largest market for solar home systems worldwide, with 4 million units sold. Fossil fuels comprise up to 98% of total installed

capacity, 65% of which is gas, and generation deficits in recent years have been met by oil- and diesel-powered private generators. IPPs provide about half of the country's generation capacity. Delays to the introduction of a feed-in-tariff (itself very limited) frustrated the government's goal of reaching 500MW solar PV capacity by 2016.<sup>16</sup>

Nepal has more than enough hydropower potential to meet its energy needs, but its capacity remains at around 780MW (against peak demand of 1,350MW), hampered by bureaucratic delays, a lack of access to financing and two major earthquakes since 2015. Hydro power provides all on-grid electricity and 30MW off-grid. Government subsidies have helped off-grid solar systems gain a foothold in Nepal, with 700,000 systems (15MW) sold to date according to official figures, and a well-developed value chain and supportive distributed generation policies.<sup>17</sup>

## **India**

India is the third-largest power generator globally after the US and China, with installed capacity of 290GW by the end of 2015, of which 15% was renewable. Peak power demand in India increased 3.7% in 2015, to 153GW (with a peak shortage of 4.6GW), and is projected to increase to 165GW by the end of FY 2016-17 (with an expected peak surplus of 4.2GW).<sup>18</sup> 50% of the rural population is reliant on traditional biomass for cooking, and 244 million people lack reliable access to electricity.<sup>19</sup>

**Policies** - India's NDC aims to reduce emissions intensity by 33-35% below 2005 levels by 2030. The corresponding official targets are 40% electricity generation from renewable sources by 2030, and 175GW renewable energy generation (not including large hydro, defined as above 25MW) by 2022. The target includes 100GW of solar PV (including 40GW rooftop solar), 60GW of wind power, 10GW biomass and 5GW small hydropower. Feed-in-tariffs have been in place since 1993, revised and set on a subnational basis. Utilities have mandated renewable energy quotas and a renewable energy certificate (REC) market has been in operation for several years. Net metering is being rolled out nationally, but limited distribution utility capacity is delaying the process.<sup>20</sup>

A new single tax regime for goods and services introduced in August 2016 revokes some fiscal incentives for renewable energy, increasing the cost of grid-connected solar power by 12-16%, wind by 11-15%, but compensating mechanisms may be put in place to offset this. A 30% capital subsidy for rooftop solar PV installation is in place, and is expected to support 4.2GW in

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<sup>16</sup> ClimateScope. 2016. "Bangladesh." <http://global-climatescope.org/en/country/bangladesh/#/details>

<sup>17</sup> ClimateScope. 2016. "Nepal." <http://global-climatescope.org/en/country/nepal/#/details>

<sup>18</sup> ClimateScope. 2016. "India." <http://global-climatescope.org/en/country/india/#/details>

<sup>19</sup> REN21. 2017. "Global Status Report."

<sup>20</sup> ClimateScope. 2016. "India."



new capacity. The government plans to invest \$11bn in rural electrification by 2022 to reach all unelectrified villages, but 7,400 villages remain without electricity as of September 2016.<sup>21</sup>

**Technologies** - Current renewable capacity is 94GW, or 46GW excluding large hydropower facilities. Of new capacity installed in 2016, 3.6GW was wind power (up from 2.6GW in 2015, partly driven by imminent expiry of incentive program), and 4.1GW solar PV (up from 2GW in 2015), which has now overtaken wind in terms of investment attracted and totals 9.1GW of capacity. Hydro capacity totals 47.5GW with 0.6GW of hydro brought online in 2006, all under 65MW in capacity. Rooftop solar expanded significantly but still totals just 10% of solar PV capacity. India is planning for 10GW distributed capacity through microgrids by the end of 2019. 3.1 million off-grid solar systems were sold in 2016 (up from 2.5 million in 2015). India is the 3<sup>rd</sup> largest solar PV market in Asia after China and Japan and the only Asian country with solar CSP under construction. India has seen sharp increases in ethanol production and increased advanced biofuel production capacity, with 10% of heat demand met by bioenergy. The weighted average levelized cost of energy (LCOE) from renewable sources has fallen by a significant 68% since 2010 to \$0.09 per kWh, with wind at \$0.065 per kWh, solar PV at \$0.09, and CSP at \$0.22.<sup>22</sup>

**Market growth, trends and private sector** - India's clean energy sector is considered "exceptionally" well developed, with 19 service providers and 34 value chains. Climatescope ranks India's clean energy market 6<sup>th</sup> globally and 2<sup>nd</sup> regionally, aided by the presence of wholesale power markets and independence of power generation and growing transmission infrastructure.<sup>23</sup> REN21 classifies India as the 4<sup>th</sup> largest country in net capacity addition in 2016 for wind, solar PV and solar thermal, 3<sup>rd</sup> for solar CSP, 5<sup>th</sup> for geothermal and 5<sup>th</sup> for renewable energy in general.<sup>24</sup>

The off-grid residential solar market is active, with 40+ established players, but none have achieved sufficient scale yet. Larger companies have been awarded government tenders, but struggle to sustain a pipeline of direct customer sales. Most providers sell under 5,000 units a year at 1-5% operating margins. Few companies have yet achieved profitability and most need to scale 2-4 times to break even.

India has seen \$48.3bn in clean energy investment from 2011-15, with a growth rate of 30%. \$2.5bn of this is private equity/venture capital, \$2.9 in corporate finance, and the vast majority, \$43bn, asset finance. New investment in 2015 totaled \$11.2bn, almost evenly split between wind and solar, up from \$9bn the previous year. This fell to \$9.2bn in 2016, with solar taking the majority share of \$5.5bn, and wind \$3.7bn. Meeting India's targets will require \$189bn in

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<sup>21</sup> Ibid.

<sup>22</sup> REN21. 2017. "Global Status Report."

<sup>23</sup> India is rapidly adding transmission infrastructure – with 28,000 km of transmission and 62.849 MVA transformer capacity added in 2016.

<sup>24</sup> REN21. 2017. "Global Status Report."

additional investment by 2022, of which \$132bn in debt, \$57bn in equity,<sup>25</sup> and \$292bn by 2030 based on planned and targeted capacity. In addition, the market opportunity for off-grid is projected at \$215m by 2018.<sup>26</sup>

### Investment Opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	1.040	1'179.5	849.5	2'110
Geothermal	2.169	13.0	0.0	28.2
Hydro	1.519	106'764.8	0.0	162'176
Solar	1.030	9'091.2	80'914.8	92'706.2
Wind	1.100	4'233.7	27'471.3	34'875.5
<b>Total</b>				<b>291'896</b>
<b>Total (no hydro)</b>				<b>129'720</b>

#### 1.3.2 SOUTHERN AFRICA

South Africa holds the lion's share of the continent's electricity generation capacity, and has close investment and electricity market development links with Zambia and Mozambique. The latter uses parts of South Africa's transmission infrastructure to supply large industry, and Swaziland, with power. Despite being coal-heavy, South Africa's clean energy tender program for utility-scale solar and wind has been successful, albeit problems remain - the national utility, Eskom, recently declined to sign PPA agreements for wind and solar plants without pricing reforms.

Zambia and Mozambique are both heavily reliant on large hydro, thus exposed to low water levels in dry months. Record low-priced PPAs have been awarded to two utility-scale solar facilities in Zambia, supported by large implicit subsidies to electricity (the government embarked on a tariff reform program in 2016 to mitigate this issue). Constrained distribution infrastructure in Mozambique and hydro shortages in Zambia are providing impetus to off-grid generation in those countries, with policy support for solar home systems and distributed resources helping to improve the investment environment.

<sup>25</sup> Sen, V., K. Sharma and G. Shrimali. 2016. "Reaching India's Renewable Energy Targets: The Role of Institutional Investors." Climate Policy Initiative. <https://climatepolicyinitiative.org/publication/reaching-indias-renewable-energy-targets-role-institutional-investors/> Note that this paper calculates total investment potential to be \$411bn, using a different methodology. The ballpark figure is around \$350-\$400bn.

<sup>26</sup> The Climate Group. 2015. "The Business case for Off-Grid Energy in India."

<https://www.theclimategroup.org/sites/default/files/archive/files/The-business-case-for-offgrid-energy-in-India.pdf>

## **South Africa**

South Africa produces 85% of Southern Africa's power and is a net exporter. Its recent clean energy record is mixed and its main source of power remains coal.<sup>27</sup> South Africa has installed renewable capacity of 2.5GW and 88% of the population is grid/connected.<sup>28</sup>

**Policies** - The 2010 Integrated Resource Plan aims to increase total capacity from 43GW to 89.5GW in 2030, with wind and solar contributing 20% (from 5% in 2015). In May 2016, Expressions of Interest were requested for 1.5GW of solar (PV and thermal) to develop local manufacturing in the Northern Cape. The biofuels blending mandate is delayed, but a regulatory framework is expected soon. A carbon tax has been announced but not yet implemented – it is controversial owing to implications for national utility Eskom, and the mining sector.<sup>29</sup> Cape Town has committed to 20% renewables by 2020 and the country targets 17.8GW renewable energy capacity by 2030, with 42% new installed capacity from 2010-2030 being renewable.<sup>30</sup>

**Technologies** - South Africa has the largest renewable energy capacity in Africa, along with Ethiopia, reaching 5% of generation in 2016. South Africa led the world in new installed solar CSP capacity in 2016 with 100MW coming online, for a total of 200MW, fourth-largest globally. An additional 300MW will come online by 2019 and electricity costs have fallen 43% over five bid cycles. South Africa leads Africa in new installed solar thermal capacity (chiefly to reduce peak demand in tight markets) and installed 0.5GW of PV in 2016, though these attracted very low bids for the electricity. Bioethanol and biofuel production is increasing. 2016-17 saw 1.3GW pumped-storage hydro capacity installed. South Africa has the highest wind potential in Southern Africa,<sup>31</sup> but onshore wind saw modest additions of 0.4GW despite being the most cost-effective option for new grid-connected power.<sup>32</sup>

**Market growth, trends and private sector** - The transmission system is not independent and the electricity value chain is not unbundled, and Eskom generates 95% of power and is the sole purchaser of electricity. However, there are no major barriers to private sector participation in generation: private IPPs are establishing themselves with renewable power projects. The fourth round of the program saw 26 projects become preferred bidders, putting 2.2GW of wind and solar PV on track for commissioning between 2017-19. The number and range of companies serving the clean energy sector is high, and the country scored highest on carbon pricing and

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<sup>27</sup> IRENA. 2015. "Africa Power Sector: Planning and Prospects for Renewable Energy."

[http://www.irena.org/DocumentDownloads/Publications/IRENA\\_Africa\\_Power\\_Sector\\_synthesis\\_2015.pdf](http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_Power_Sector_synthesis_2015.pdf)

<sup>28</sup> ClimateScope. 2016. "South Africa." <http://global-climatescope.org/en/country/south-africa/#/details>

<sup>29</sup> Ibid.

<sup>30</sup> REN21. 2017. "Global Status Report."

<sup>31</sup> IRENA. 2015. "Africa Power Sector."

<sup>32</sup> Ibid.

offset policies.<sup>33</sup> Investment fell sharply to \$900m in 2016, owing to delayed auctions and difficulties in securing PPAs for awarded projects.<sup>34</sup>

The growth rate of clean energy investments is 34.2%, and investment from 2011-2015 totaled \$16bn, of which only \$22.6m was VC/PE financing, and none corporate financing, and the rest asset financing. Loans and grants made up \$1.6bn of this total, and local investment only \$9m. Slow growth in installation and generation overall saw South Africa score poorly on Climatescope's enabling environment assessment, but very well on investment, with \$4bn in clean energy investment in 2015 alone.

### Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	3.660	90.8	0.0	332
Geothermal	5.110	0.0	0.0	0.0
Hydro	1.593	1948.5	0.0	3'104
Solar	1.490	1'452.2	6'189.8	11'386.6
Wind	1.680	1'432.6	6'242.4	12'894.0
<b>Total</b>				<b>27'717</b>
<b>Total (no hydro)</b>				<b>24'613</b>

### Mozambique

Mozambique's GDP rose 7.3% on average from 2011-15, with power demand growing 11.8%.<sup>35</sup> The electrification rate is approximately 29%.<sup>36</sup> Ageing electrical infrastructure means distribution capacity is constrained, particularly in the North. The hydro-dominated power sector is likely to change after the discovery of large coal and offshore gas reserves in recent years. Mozambique exports hydro power to neighboring countries.<sup>37</sup> It is considered a high-impact country for energy access efforts.<sup>38</sup>

**Policies** - A feed-in-tariff was published in 2014 with price premiums for small projects (under 10MW) in biomass, small hydro, solar and wind. In 2011, a biofuels blending mandate was introduced, along with a tax incentive scheme, targeted at attracting foreign investment.<sup>39</sup> A

<sup>33</sup> ClimateScope. 2016. "South Africa".

<sup>34</sup> REN21. 2017. "Global Status Report."

<sup>35</sup> ClimateScope. 2016. "Mozambique." <http://global-climatescope.org/en/country/mozambique/#/details>

<sup>36</sup> International Energy Agency (IEA). 2017. "Energy Access Outlook 2017 – World Energy Outlook Special Report." [https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_EnergyAccessOutlook.pdf](https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_EnergyAccessOutlook.pdf)

<sup>37</sup> ClimateScope. 2016. "Mozambique."

<sup>38</sup> Sustainable Energy for All. 2017. "Energizing Finance: Scaling and Refining Finance in Countries with Large Energy Access Gaps". Washington, DC. [http://www.se4all.org/sites/default/files/2017\\_SEforALL\\_FR4P.pdf](http://www.se4all.org/sites/default/files/2017_SEforALL_FR4P.pdf)

<sup>39</sup> ClimateScope. 2016. "Mozambique."

renewable heat policy was under development in 2016, following South Africa's example. Mozambique has undated targets for rural solar heat systems (100,000), rural biogas systems (1,000) hydro, solar PV and wind (2GW each) and home solar PV (82,000 systems).

**Technologies** - Installed generation capacity in 2014 was 2.2GW, of which 2.1GW was a single large hydro facility. Small-scale thermal power and small hydro make up most of the rest, and installed renewable capacity is 57.6MW. Biofuels are an important development sector.<sup>40</sup> In October 2016, a 25-year PPA was signed for Mozambique's first large-scale solar plant, a 40MW grid-connected facility serving the northern regions.<sup>41</sup>

**Market growth, trends and private sector** – In Mozambique The National Electricity Council regulates the grid, and the National Fund for Rural Electrification implements off-grid projects. Two companies operate in generation, three in transmission and there is a state monopoly on distribution. The dominant power company, EDM, has 5% generation and controls most transmission and distribution, and owns 92.5% of HCB, which owns the country's large hydro plant. MoTraCo transmits power to large industry and Swaziland, using Eskom's (South Africa) transmission system. In 2011, the Public Private Partnership law opened up space for IPPs to participate in the generation market. There are currently gas (100MW), coal (900MW) and large hydro (1.5GW) facilities under development, with prices negotiated on a per-contract basis.<sup>42</sup>

Renewable energy investment from 2011-15 was just \$2m, all in asset financing and all locally funded. The country is key in reducing emissions due to its high energy intensity (16.8 MJ/\$ in 2011 PPP GDP, among the highest in developing countries), however Climatescope<sup>43</sup> gives Mozambique a poor overall score on the overall supporting environment for climate change, ranking it at the 48<sup>th</sup> place.<sup>44</sup>

### Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	4.030	13.0	0.0	52
Geothermal	3.980	0.0	0.0	0.0
Hydro	1.593	5'045.0	0.0	8'037
Solar	2.660	41.5	0.0	110
Wind	1.250	0.0	0.0	0.0
<b>Total</b>				<b>8'199</b>
<b>Total (no hydro)</b>				<b>163</b>

<sup>40</sup> Ibid.

<sup>41</sup> Norfund. 2016. "Mocuba – Mozambique's first large scale solar plant."

<https://www.norfund.no/nyhetsarkiv/mocuba-mozambique-s-first-large-scale-solar-plant-article10292-1011.html>

<sup>42</sup> ClimateScope. 2016. "Mozambique".

<sup>43</sup> Ibid.

<sup>44</sup> Its highest score was on low carbon business and a robust distributed energy framework. The poor enabling environment and investment environment scores reflected the high cost of debt and minimal investment in clean energy to date.

### 1.3.3 EAST ASIA & PACIFIC

East Asia & Pacific is one of the most populated regions, and home to many of the largest energy consumers in the world. Yet the energy use patterns and development potentials are very diverse across different countries in the region.

In the north, Mongolia has abundant resources in renewables as well as fossil energy, but the electricity mix is traditionally dominated by coal power. Potential renewable development opportunities exist in the solar and wind sector especially as the country upgrades the grid system in urban centers and extends electricity service to its increasing rural population.<sup>45</sup>

In the greater Mekong River sub-region, Myanmar, Cambodia, and Lao PDR are among the least developed countries, with around one-third of the population left without electricity access. With recent economic and political reforms, these countries have seen opportunities to provide electrification to most of the population in the next decade. Hydropower has already become the dominant generation source, and the rapid growth trend is expected to continue. Non-hydro renewables are playing a more limited role, however with increasing environmental concerns related to large hydro plants, the situation may improve.

Further south in South-East Asia, Indonesia, Vietnam, and the Philippines are characterized by relative high electrification rates, rapidly growing electricity demand, and significant fossil fuel resources. Developing efficient coal power generation technology is one of the top priorities of these countries, however the governments have also set up ambitious clean energy goals and policies including Feed-in Tariffs for wind, solar, hydro, waste, and biomass, to incentivize clean energy development. Moreover, geothermal power has also seen remarkable development, with Indonesia and the Philippines being two of the three biggest geothermal producers in the world.

#### **Cambodia**

Cambodia is one of the least developed countries in Asia and Pacific region, with income per capita merely one-fifth of the regional average. Around 40% of the population in Cambodia are still without access to electricity in 2016.<sup>46</sup>

There is no single, integrated electricity grid in Cambodia. Electricity prices are among the most expensive in the region, due to the high cost of imported diesel fuel and shortage of transmission lines, and the electricity is even more expensive in rural areas.

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<sup>45</sup> U.S. Department of Commerce. 2017. "Mongolia – Energy Generation."

<https://www.export.gov/article?id=Mongolia-Energy-Generation>

<sup>46</sup> International Energy Agency (IEA). 2017. "Southeast Asia Energy Outlook 2017."

[http://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport\\_SoutheastAsiaEnergyOutlook.pdf](http://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_SoutheastAsiaEnergyOutlook.pdf)

**Policies** - The country has developed very fast in recent years, setting ambitious targets to provide energy access to the majority of the population by 2030. Meeting demand for energy access demand has been the main driver for electricity sector growth in Cambodia, and renewable energy could potentially play a major role in delivering new electricity generation.<sup>47</sup> Cambodia has set a goal to achieve universal electrification for all villages by 2020, and 70% electrification for households by 2030. The country also intends to increase hydropower capacity to 2241 MW by 2020. In the meantime, it has a carbon intensity target to reduce GHG emissions by 27% from the baseline level by 2030 with international support.<sup>48</sup>

**Technologies** - The power mix mainly consist of hydropower, coal, and oil. The country imports electricity from neighboring countries, especially during the dry season.<sup>49</sup>

**Market growth, trends and private sector** - Although the government has limited funding for power generation projects as well as other infrastructure development, it welcomes private financing and ownership in the power sector, and has indicated a goal to seek for \$3 billion investment in the next decade.<sup>50</sup> Cambodia has seen rapid growth in hydropower generation. In fact, hydropower has become the dominant energy source in Cambodia, with a share of 50% in the energy mix in 2015. A significant amount of the region's hydro resources is still untapped, and further development in hydropower is expected to meet local demand growth.<sup>51</sup> By comparison, non-hydro renewables are playing a limited role in Cambodia. However, with increasing environmental concerns related to large-scale hydropower, solar PV and wind energy options may become viable alternatives, especially in solar, of which the country is abundant<sup>52</sup>. Because of the unreliable nature of electricity supply and lack of access to electric grid in the rural areas, diesel generators as backup power, as well as off-grid solutions have a significant market potential.<sup>53</sup>

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<sup>47</sup> Ibid.

<sup>48</sup> Ibid.

<sup>49</sup> U.S. Department of Commerce. 2017. "Cambodia – Power Generation Equipment." <https://www.export.gov/article?id=Cambodia-power-generation-equipment>

<sup>50</sup> U.S. Department of Commerce. 2017. "Cambodia – Power Generation Equipment."

<sup>51</sup> IEA. 2017. "Southeast Asia Energy Outlook 2017."

<sup>52</sup> IRENA. 2013. "Renewable Energy Country Profiles: Asia."

[http://www.irena.org/DocumentDownloads/Publications/\\_AsiaComplete.pdf](http://www.irena.org/DocumentDownloads/Publications/_AsiaComplete.pdf)

<sup>53</sup> IEA. 2017. "Southeast Asia Energy Outlook 2017."

## Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	1.318	21.5	n/a	28.3
Geothermal	3.116	0.0	n/a	0.0
Hydro	1.446	2178.6	n/a	3'150.3
Solar	1.414	10.0	n/a	14.1
Wind	1.263	0.0	n/a	0.0
<b>Total</b>				<b>3'192.8</b>
<b>Total (no hydro)</b>				<b>42.5</b>

## Mongolia

In Mongolia, energy supply is dominated by fossil fuels, with coal representing 70% of the primary energy supply, and oil and solid biofuels taking up 24% and 6% respectively in 2009.<sup>54</sup>

Installed half a century ago, Mongolia's primary electricity grid is not only insufficient in meeting the demand from urban centers today, but also left rural population off-the-grid. With the delayed implementation of planned projects, a large part of the country is dependent on electricity import from Russia and China.<sup>55</sup> In 2010, around 33% of the population remain without electricity access.<sup>56</sup>

**Policies** - The top priority for the government is to establish a stable electricity supply to meet its growing domestic demand. The country also hopes to become an electricity exporter to North and East Asian countries primarily through renewable energy generation. According to the Ministry of Energy, Mongolia's goals in the energy sector are to increase base load generation (mainly modern coal plants and hydro plants), develop combined heat and power (CHP) as well as energy storage capacity to manage variable energy inputs, and also improve energy efficiency. In 2013, the government set a goal to increase the share of renewable energy in total installed capacity from 7% to 20% by 2023, and to 30% by 2030. Mongolia has introduced Feed-in-Tariffs for wind and solar energy and equipment tax reductions to incentivize renewable energy development.<sup>57</sup>

**Technologies** - Mongolia is rich in wind and solar resources, and abundant in hydropower resources in some regions, making it suitable to develop various types of renewable energy

<sup>54</sup> IRENA. 2013. "Renewable Energy Country Profiles: Asia."

<sup>55</sup> U.S. Department of Commerce. 2017. "Mongolia – Energy Generation."

<sup>56</sup> IRENA. 2013. "Renewable Energy Country Profiles: Asia."

<sup>57</sup> U.S. Department of Commerce. 2017. "Mongolia – Energy Generation."



projects, including concentrated solar. Distributed energy solutions based on a combination of renewables and energy storage would be most useful for rural and remote areas.<sup>58</sup>

**Market growth, trends and private sector** - The country recognize the need to provide a stable framework for renewable power development, and projects may qualify concessional arrangements with the government.<sup>59</sup>

The country's first utility-scale wind farm came online in 2013, and since then a number of wind, solar, and small-hydro projects are in the pipeline in response to the government's renewable energy development target.<sup>60</sup>

### Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	1.318	0.0	n/a	0.0
Geothermal	3.116	0.0	n/a	0.0
Hydro	1.446	412.2	n/a	596
Solar	1.414	80.0	n/a	113
Wind	1.263	102.0	n/a	129
<b>Total</b>				<b>838</b>
<b>Total (no hydro)</b>				<b>242</b>

#### 1.3.4 EAST AFRICA

East Africa is a priority area for energy access, with low electrification rates and significant potential for off-grid energy solutions. Kenya is a particularly strong example, with a sophisticated value chain in distributed energy and mobile payment systems helping to diversify payment risks and enhance creditworthiness of the customer base. Kenya has large geothermal resources, Uganda large hydro resources, and Rwanda very few domestic resources but a robust policy environment supporting development of small-scale bioenergy and minigrids. Private investment in both on- and off-grid solar in the region is rising, supported by feed-in-tariffs, although Kenya is in the process of replacing them with a tender system.

### Kenya

Excluding large hydropower, 46% of total power generation in Kenya was renewable, with 691MW installed capacity. Kenya's relatively stable power supply and policy framework have attracted a significant developer pipeline in renewable energy. Peak electricity demand in FY2014-15 was 1.5GW, growing at 3% per year. This is half the growth rate seen in recent years,

<sup>58</sup> Ibid.

<sup>59</sup> Ibid.

<sup>60</sup> Ibid.

and rapid installation of new capacity has led to a peak oversupply of 700MW, and power generation is growing by 60% per year owing to a handful of large geothermal and wind projects. Supply interruptions are now rare as a result. 84% of the population use solid fuel for cooking.<sup>61</sup> With electrification rates at approximately 65%,<sup>62</sup> Kenya is considered a high-impact country for energy access by SE4All, with a policy-driven, integrated electrification strategy mixing on- and off-grid solutions.<sup>63</sup>

**Policies** - The government is targeting 100% energy access by 2022, and 100% renewable energy by 2050. This is accompanied by a 5GW geothermal target by 2030.<sup>64</sup> Kenya's INDC targets a 30% emissions reduction by 2030. In 2016, the Kenyan government announced its intention to replace the nationwide feed-in-tariff (\$0.12 per kWh) with a system of government tenders for power contracts. In the interim, all renewable energy sources benefit from the tariff, although oversupply in the generation market has reduced the incentives for rapid completion. The government is leading an expansion of distribution lines and optimization of the existing transformer network to expand electricity access.

The government allocates 2-3% of GDP to electricity; 21-24% of electricity finance is domestically sourced, and 50% allocated to on-grid generation, with most of the remaining 50% going towards transmission and distribution. 100% of financing is concessional (usually through the provision of government guarantees), and 40% goes towards residential energy access.<sup>65</sup>

**Technologies** - Geothermal power in Kenya is a major success. The state-owned Geothermal Development Company takes on expensive exploration work, then tenders verified sites to developers. Geothermal power made up 27% of installed capacity in 2015.<sup>66</sup> Kenya added 29MW in geothermal capacity in 2016 (to its now-139MW Olkaria plant), third globally behind Indonesia and Turkey and one of few countries to do so.<sup>67</sup> IRENA estimates Kenya's additional geothermal potential at 3GW, twice as much as the rest of East Africa, and suggests it could supply 60% of Kenya's energy mix by 2030.<sup>68</sup> Kenya's first 2MW biogas CHP plant began production in 2016, and there are 17,554 domestic biogas facilities across the country. A transmission interconnection is being completed with Ethiopia; Kenya expects to import electricity from Ethiopia's 1.87GW Gibe III hydropower project.<sup>69</sup>

Kenya has a handful of large solar PV projects with a typical size of 40MW, expected to sign PPAs in the near future. An additional 900MW of solar PV expressions of interest have been

<sup>61</sup> ClimateScope. 2016. "Kenya." <http://global-climatescope.org/en/country/kenya/#/details>

<sup>62</sup> IEA. 2017. "Energy Access Outlook 2017."

<sup>63</sup> Sustainable Energy for All. 2017. "Energizing Finance."

<sup>64</sup> REN21. 2017. "Global Status Report."

<sup>65</sup> Sustainable Energy for All. 2017. "Energizing Finance."

<sup>66</sup> ClimateScope. 2016. "Kenya."

<sup>67</sup> REN21. 2017. "Global Status Report."

<sup>68</sup> IRENA. 2015. "Africa Power Sector."

<sup>69</sup> REN21. 2017. "Global Status Report."

approved. The lengthy approval processes for utility scale projects have diverted some developers into the on-site power markets, usually solar PV or solar thermal projects generating under 1MW.<sup>70</sup> Over 30% of Kenya's off-grid population have a solar product at home, and 2 million off-grid solar systems were sold in 2015-2016. The 310MW Lake Turkana wind farm, Africa's largest, is coming online in 2018 and will provide 15% of Kenya's generation capacity.<sup>71</sup>

**Market growth, trends and private sector** - The energy market of Kenya is not fully liberalized but is making steady progress towards unbundling of distribution, retail and transmission. The transmission system does not operate on a market-based dispatch model and there are significant barriers to private sector participation, although the government has mandated the state transmission company to compete with private sector rivals. There is no competitive wholesale market for electricity, although the generation market is relatively competitive,<sup>72</sup> With ongoing liberalization of power generation markets having seen 13 Independent Power Producers establish themselves. Climatescope ranks Kenya as the third best clean energy market in Africa, behind South Africa and Uganda, and tenth globally, performing best on low-carbon business and clean energy value chains. The enabling environment has improved slightly over the past two years, particularly in the distributed energy and off-grid sectors.<sup>73</sup> Kenya has a relatively large number of service providers and comparatively diverse value chains in the clean energy sector and the country is seeing an increase in carbon offset activity and corporate emissions disclosure and sustainability policies.

Kenya's total electrification rate grew from 26% in 2012 to 47% in mid-2015 (including off-grid), though SE4All suggests only 32% of the population is being reached.<sup>74</sup> The remaining population is one of the world's best-served off-grid communities, with advanced pay-as-you-go solar home system companies now operating in the (rapidly growing) market.<sup>75</sup> Kenya saw \$600m in clean energy investment in 2016,<sup>76</sup> up 30% from \$484m in 2015. Of the latter figure, only \$50m was provided in loans and grants (the rest as equity or guarantees), and only \$16m was from local sources. Asset finance made up the overwhelming majority of the \$2.88bn cumulative 2011-15 investment, with venture capital contributing \$35.5m. Developers and the government secured financing for 9.6MW in solar mini-grids in 2016. BBOXX and Mobisol raised investment to finance operations in Kenya, and crowdfunding for clean cookstoves is gaining popularity.<sup>77</sup>

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<sup>70</sup> ClimateScope. 2016. "Kenya."

<sup>71</sup> REN21. 2017. "Global Status Report."

<sup>72</sup> ClimateScope. 2016. "Kenya."

<sup>73</sup> Ibid.

<sup>74</sup> Sustainable Energy for All. 2017. "Energizing Finance."

<sup>75</sup> ClimateScope. 2016. "Kenya."

<sup>76</sup> Ibid.

<sup>77</sup> REN21. 2017. "Global Status Report."

## Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	2.340	50.2	1'345.4	3'265.7
Geothermal	4.040	730.0	3'330.0	16'402.4
Hydro	1.593	1196.6	0.0	603
Solar	2.120	599.2	0.0	1'270
Wind	2.600	805.1	2'171.0	7'737.6
<b>Total</b>				<b>29'279</b>
<b>Total (no hydro)</b>				<b>28'676</b>

## Uganda

With a 19% electrification rate,<sup>78</sup> Uganda's power demand is growing at 4% annually. 97% of the population use solid fuels for cooking.<sup>79</sup> Uganda has domestic gas reserves, 2-3GW of untapped hydro potential and, with an upgraded transmission system, could be a major exporter of hydroelectricity to fossil fuel-dependent countries.<sup>80</sup>

**Policies** - Uganda is targeting 61% renewable energy generation by the end of 2017, including 1.2GW large hydro, 30MW biopower, 45MW geothermal and 85MW small hydro. Uganda operates an LED distribution program and has energy efficiency standards for appliance equipment, though these are hard to enforce.<sup>81</sup> A feed-in-tariff supports renewable energy generation across small hydro, solar PV and biomass. The policy was boosted in 2013 to fast-track 150MW of small projects, and a standardized PPA model established. The government is targeting 1.4m additional grid connections by 2022, and aims to boost rural electrification to 26%, aiming for universal access by 2035. Solar enjoys tax exemptions on equipment and subsidies for end users. Credit enhancements are available to the private sector through the (internationally financed) Energy Credit Capitalization Company through technical assistance, working capital for PAYGO solar, grid connection costs and installation of solar PV systems.<sup>82</sup>

**Technologies** - Of the 900MW total clean energy generation capacity, most is large state-owned hydro and 17% is small hydro and biomass cogeneration (155MW). An additional 600MW large hydro project (supported by China) will come online in 2018. Biofuel production to date is lacklustre, and may be boosted by a 2016 blending mandate law. A bioethanol

<sup>78</sup> IEA. 2017. "Energy Access Outlook 2017."

<sup>79</sup> ClimateScope. 2016. "Uganda." <http://global-climatescope.org/en/country/uganda/#/details>

<sup>80</sup> IRENA. 2015. "Africa Power Sector."

<sup>81</sup> REN21. 2017. "Global Status Report."

<sup>82</sup> ClimateScope. 2016. "Uganda."

plant was commissioned in September 2016.<sup>83</sup> 2016 saw more solar PV plants commissioned and a doubling in distributed solar system sales to 0.4m (0.2m in 2016).<sup>84</sup>

**Market growth, trends and private sector** - Uganda is one of few Sub-Saharan countries with a liberalized energy market across generation and transmission (unbundled in 2001). Distribution is dominated by Umeme, a public company with a 20-year concession. The major transmission and generation companies are state owned and mandated to support policy objectives. IPPs make up 58% of generation, set to grow in the near term. Value chains and low-carbon business is well-developed and there are relatively low barriers to entry and low offtaker risk, supported by a strong policy environment, particularly in distributed generation.<sup>85</sup> Clean energy is a fast-growing sector, driven by a feed-in-tariff supporting 157MW of projects expected to be commissioned by 2018. Uganda saw \$183m clean energy investment in 2015 (up from \$50m in the previous four years), of which \$2.5m was private equity and the remainder asset financing. By end 2015, 17 projects were approved (117MW small hydro, 20MW solar PV, 20MW biomass) that will increase non-large hydro capacity by 123%. Growth is constrained by grid capacity – international donor funding for transmission and distribution is experiencing delays in implementation. The solar PV market has attracted foreign investment and 200 companies operate in the sector. The lack of rural grid access, and telecoms growth, have boosted off-grid solar, but when the 600MW large hydro comes online in 2018, growth may be dampened over a period of overcapacity. Microgrids are being built for 144,000 customers with solar PV, mini-hydro and biomass, funded by private developers and local communities.<sup>86</sup> Sweden donated \$4.3m to the CleanStart program targeting clean energy for 150,000 households by 2022. Uganda is a beneficiary of Arc Finance's renewable energy microfinance program and a \$2.2m World Bank clean cooking project.<sup>87</sup>

### Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	4.950	37.6	13.0	186
Geothermal	3.980	150.0	0.0	597.0
Hydro	1.593	2'097.7	0.0	3'342
Solar	1.570	25.0	0.0	39
Wind	2.560	0.0	0.0	0.0
<b>Total</b>				<b>4'164</b>
<b>Total (no hydro)</b>				<b>822</b>

<sup>83</sup> Ibid.

<sup>84</sup> REN21. 2017. "Global Status Report."

<sup>85</sup> ClimateScope. 2016. "Uganda."

<sup>86</sup> Ibid.

<sup>87</sup> REN21. 2017. "Global Status Report."

## **Rwanda**

Rwanda has a small but innovative energy sector. Of 160MW installed capacity in 2015, 87MW was renewable. The government is targeting 563MW capacity by June 2018, which it is unlikely to achieve, but it is likely to expand capacity to at least 444MW. Power costs are 50% higher than those of its neighbours, and power demand is growing by 13.5% annually.<sup>88</sup> The electrification rate is approximately 30%.<sup>89</sup>

**Policies** - Rwanda's renewable energy targets aim for 300MW biogas, 310MW geothermal, 340MW hydro and 5MW off-grid capacity, with date unspecified. There are targets for 70% electricity access by 2018 (22% off-grid) and 100% access by 2030, and 100% renewable generation by 2050.<sup>90</sup>

To support its 2018 capacity target, the government has introduced utility reforms, tenders, unsolicited proposals, tax breaks, minigrid innovation, and international donor banking to accelerate progress. There is a standardized PPA process. The feed-in-tariff, previously used to support small hydro, is being reviewed, with 26MW hydro and 12MW solar and bioenergy capacity expected to be supported through to 2018.<sup>91</sup>

**Technologies** - Meeting the 2018 target will require at least 80MW of hydro, 40MW solar PV, 150MW through grid interconnections with other countries, 75MW methane, 85MW peat and the remainder from fuel oil. In 2015, hydro supplied 57% of the country's electricity, and solar 3%. 37% was supplied by diesel oil, but this will fall as a 100MW methane recovery facility comes fully online. Over 100,000 solar home systems were sold in 2016.<sup>92</sup>

**Market growth, trends and private sector** - Rwanda has made gains in almost all areas, according to Climatescope, and its enabling framework is ranked 2<sup>nd</sup> globally. Distributed energy frameworks and power sector restructuring have helped this. The power sector is not unbundled, and there is no independent transmission and distribution.<sup>93</sup> The Rwanda Electricity Group contracts capacity through a competitive tender process, with 20-25 year take-or-pay arrangements. Off-grid or mini-grid generation projects require a license from the regulator, tenable for 5-25 years; distributed resources and mini-grids can now set their own tariffs within a reasonable rate of return, and the licensing process is limited by law to 60 days. The Energy Development Corporation supports new capacity development within the company and with IPPs.<sup>94</sup> Despite the sector restructuring, no new investment in clean energy was seen in 2015, although venture capital and private equity investors are present in the country. Rwanda is

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<sup>88</sup> ClimateScope. 2016. "Rwanda." <http://global-climatescope.org/en/country/rwanda/#/details>

<sup>89</sup> IEA. 2017. "Energy Access Outlook 2017."

<sup>90</sup> REN21. 2017. "Global Status Report."

<sup>91</sup> Ibid.

<sup>92</sup> Ibid.

<sup>93</sup> ClimateScope. 2016. "Rwanda."

<sup>94</sup> Ibid.

part of the World Bank Partnership for Market Readiness program. Rwanda saw \$157m in clean energy investment from 2011-15, all of which was in asset finance (as opposed to corporate finance and venture capital), and \$17m was local investment.<sup>95</sup> In 2016, Rwanda received investment from private solar developers BBOX and Mobisol, and \$480,000 from the African Development Bank for minigrid development.<sup>96</sup> Utility scale solar and biomass are expected to play significant roles in the country's energy development. There is no large-scale wind potential in Rwanda.<sup>97</sup>

### Investment opportunity

Technology	Cost per MW (\$ million)	Additional MW planned	Additional MW targeted (by 2030)	Investment opportunity (\$ million)
Biomass	5.680	80.6	203.6	1'614.1
Geothermal	4.050	10.0	300.0	1'255.5
Hydro	1.593	121.9	137.9	413.8
Solar	2.580	10.0	0.0	26
Wind	1.660	0.0	0.0	0.0
<b>Total</b>				<b>3,309</b>
<b>Total (no hydro)</b>				<b>2,895</b>

<sup>95</sup> ClimateScope. 2016. "Rwanda."

<sup>96</sup> REN21. 2017. "Global Status Report."

<sup>97</sup> IRENA. 2015. "Africa Power Sector."

## 2. Annex 2: Investment barriers in the high impact markets selected.

To identify **key political and commercial barriers** to investment in each high impact country which could be addressed by blended finance, we referred to individual or combined country level indicators, assumed as proxies for specific risks in the region. Unless otherwise specified, risk / barriers and sub-indicators are inversely correlated. The table below summarizes main assumptions.

Risk / barriers	Sub-indicators used
Political and social risks	Country risk (attractiveness of)
Administrative barriers	Ease of doing business
Policy / regulatory risk	Country risk (attractiveness of) Electricity prices
Access to capital barrier	Access of foreign investment Access of private investment Access to affordable credit
Construction, financial, and operation costs increase and volatility	Inflation stability
Currency Risk	Currency risk (attractiveness of)
Counterparty / Offtaker / Credit Risk	Loan repayment risk (attractiveness of)
Revenues Lack of Attractiveness	Electricity prices Supporting environment for CC

Based on the approach above the following risks in the regions were identified as displayed in the graph below, with red representing relative high risk and green representing relative low risk. Other **technology-specific barriers** in the target areas were identified through desk research.



Country	Political and social risks	Administrative barriers	Policy / regulatory risk	Access to capital barrier	Construction, financial, and operation costs increase and volatility	Currency Risk	Counterparty / Off-taker / Credit Risk	Revenues Lack of Attractiveness and Volatility
India							n/a	
South Africa								
Mozambique								
Cambodia							n/a	n/a
Mongolia							n/a	n/a
Kenya								
Uganda								
Rwanda								

When it comes to the specific risk factors, we find that higher income countries generally have lower barriers to access capital, and lower policy risks. Currency risk and credit risk are significant across different income groups. Targeting these risk factors will ensure blended finance instruments realize their biggest impact.

The main barriers identified in the high impact markets identified are illustrated more specifically in the following paragraphs.

### 2.1.1 INDIA

**Political risk in India is relatively low in the clean energy context.** Support for clean energy policies in India is strong and unlikely to shift, particularly given poor air quality in urban areas and tangible climate impacts in rural areas. India's NDC and official renewable energy targets reflect the institutionalization of the low-carbon transition. Revenue attractiveness for clean energy projects is supported by feed-in-tariffs, mandatory renewable portfolio standards and renewable energy certificate markets. Once implemented, net metering and capital subsidies will provide equivalent support to rooftop solar.<sup>98</sup> Some trade barriers favor Indian manufacturing and regulatory risk (including land acquisition) may however create some concerns to investors.

<sup>98</sup> Climatescope. 2016. "India". <http://global-climatescope.org/en/country/india/#/details>

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*Insufficient access to debt and equity capital for renewable energy project developers is expected to present a challenge to meeting renewable energy targets.*

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**One of the largest barriers to investment is off-taker risk for renewable energy projects.** Despite a relatively liberalized electricity market, India's distribution utilities make an average aggregated technical and commercial loss of 25% (2014-15), and most state-owned utilities make operating losses. The sector's total debt was \$67bn in 2015, with low credit ratings for operating assets. The UDAY debt restructuring program was launched in November 2015 to increase efficiency and decrease debt servicing costs.<sup>99</sup>

**In solar and wind markets, high upfront costs and perceived performance risks are another potential perceived barrier to access to debt finance.** One risk to financing utility-scale renewable energy is weather-related volume risk – the risk of variation in the availability of natural resources for renewable energy, such as wind, sunlight and water flow.<sup>100</sup> This is of particular concern with wind power.<sup>101</sup> Banks with little access to credit assessment tools and limited information on technology performance are reluctant to lend to developers as they are already struggling with stressed loans and overexposure to infrastructure.<sup>102</sup> Most financing now is then equity-driven, which has limited potential for scaling in the rooftop market. Third-party financing (in which the developer installs, owns and operates the equipment, then sells electricity under a long-term PPA) is a proposed solution, since developers are better able to manage upfront costs and performance risk.<sup>103</sup> Insurance products covering performance and resource availability risk may also address concerns related to this investment barrier.

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*Institutional investors<sup>104</sup>, foreign and domestic, may be capable of bridging the shortfall in debt and equity financing of required renewable energy investment,<sup>105</sup> but face additional barriers.*

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**A major barrier to foreign investment includes exchange risk for financing denominated in foreign currency.** Clean energy projects in India generate revenues in local currency (in INR). Financing a renewable energy project with foreign capital (in USD) exposes foreign

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<sup>99</sup> Climatescope. 2016. "India".

<sup>100</sup> India Innovation Lab for Green Finance. 2016. "P50 Risk Solutions: Lab Instrument Analysis". [https://www.climatefinancelab.org/wp-content/uploads/2017/08/P50-Risk-Solutions\\_full-report-1.pdf](https://www.climatefinancelab.org/wp-content/uploads/2017/08/P50-Risk-Solutions_full-report-1.pdf)

<sup>101</sup> Recent record low wind scenarios in different parts of the world, including the UK in 2010, Southern Europe in 2011, Australia in 2014, and the US in 2015, have brought wind variability risk to the forefront in India.

<sup>102</sup> Sen, V., K. Sharma and G. Shrimali. 2016. "Reaching India's Renewable Energy Targets."

<sup>103</sup> Shrimali, G. 2016. "The Drivers and Challenges for Third Party Financing for Rooftop Solar Power in India." Climate Policy initiative. <https://climatepolicyinitiative.org/publication/third-party-financing-rooftop-solar-power-india/>

<sup>104</sup> Domestic institutional investors, with a lower cost-of-capital, can meet 54% of the debt gap.

<sup>105</sup> Sen, V., K. Sharma and G. Shrimali. 2016. "Reaching India's Renewable Energy Targets."

investors/project to the risk of currency devaluation over time. This has resulted in reduced investments in India due to a high perception of currency risk.<sup>106</sup>

**Remaining obstacles to renewable energy investment include administrative barriers**, taking the form of bureaucratic delays to planning and execution of projects, inconsistent policies across states, a lack of intermediaries through whom external developers and investors can access specific markets. The country has a score of 130 on the World Bank's ease of doing business index, where 1 indicates the most business-friendly environment.

**Other barriers include a shortage of liquid instruments for renewable energy investment**, suggesting that appropriate asset allocation models will need to be developed to match their required risk-return profiles with renewable energy projects and address the mismatch of return expectations between investors and developers.<sup>107</sup>

## 2.1.2 SOUTH AFRICA

**Relatively low electricity prices in South Africa are compensated by a generally strong policy and financing environment for renewables**, with robust carbon pricing and offset policies, and a successful tender program under way for several years for solar PV, solar CSP, solar thermal and wind projects.

**Currency risk has become more significant** as the Rand has exhibited greater volatility in recent months.<sup>108</sup>

**Economic contraction and delays in policy decisions in recent months have heightened the off-taker and construction-phase risk environment for new renewable capacity.** Eskom generates 95% of power and is the sole purchaser of electricity. In financial difficulty due to economic conditions, it may have to seek financing outside capital markets if South Africa's credit rating is lowered. In August 2016, Eskom sent tremors through the market by refusing to sign new PPAs unless it was given greater control over prices agreed in auction processes. As the only off-taker, refusal to sign PPAs is a major concern to IPPs, investors and suppliers.<sup>109</sup> These developments have also seen investment drop sharply from \$4bn in 2015 to under \$1bn in 2016.<sup>110</sup>

<sup>106</sup> India Innovation Lab for Green Finance. 2016. "FX Hedging Facility: Lab Instrument Analysis". [https://www.climatefinancelab.org/wp-content/uploads/2017/08/FX-Hedging-Facility\\_full-report.pdf](https://www.climatefinancelab.org/wp-content/uploads/2017/08/FX-Hedging-Facility_full-report.pdf)

<sup>107</sup> Sen, V., K. Sharma and G. Shrimali. 2016. "Reaching India's Renewable Energy Targets."

<sup>108</sup> Brand, R. 2017. "Traders Run for Cover as Storm Bears Down on South Africa's Rand." Bloomberg Markets. <https://www.bloomberg.com/news/articles/2017-09-27/traders-run-for-cover-as-storm-bears-down-on-south-africa-s-rand>

<sup>109</sup> ClimateScope. 2016. "South Africa."

<sup>110</sup> Ibid.

### 2.1.3 MOZAMBIQUE

**Political and administrative barriers in Mozambique remain high.** The policy framework for distributed resources is robust, but the enabling environment for on-grid generation remains weak, compounded by the difficulty of conducting private business in the country.

IPPs have been involved in the generation market since 2011, but **the overall attractiveness of investments is reduced by relatively low electricity prices and by the risk of revenue volatility**, heightened by the lack of standardized PPAs.

**High inflation and depreciation against the U.S. dollar contribute to high currency risks**, exposing investors and project developers to further devaluation and significant exchange rate volatility.

**Access to debt capital remains a problem, partially compensated by access of foreign investment.** The average cost of debt is high and there has been minimal external investment to date in the clean energy sector, but it is.

### 2.1.4 CAMBODIA

**High electricity prices provide good opportunities for investment in Cambodia.** Electricity prices are among the most expensive in the region, especially in rural areas.

**Currency risk is relatively low in Cambodia** as the dollarized economy minimizes currency risks.

**Administrative issues and ease of doing business can be a barrier for energy generation investments.** Cambodia ranks low in terms of the ease of starting a business, dealing with construction permits, enforcing contracts, and also getting stable electricity supply for the business development and operation.<sup>111</sup>

**Policy risk is significant in development renewable energy.** Although the government has set impressive targets to provide electricity access to the majority of the population by 2030, no specific renewable development goals are put in place except for hydropower, which is often large in scale and less environmentally friendly. Moreover, electricity generation and transmission costs are high, and lack of supporting policies such as feed-in-tariffs could put renewable energy development in disadvantage.

### 2.1.5 MONGOLIA

**Administrative barriers to entering the Mongolian energy market are relatively low.** The government has set up Public Private Partnership (PPP) and concession agreements for certain

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<sup>111</sup> GlobalEDGE. 2017. "Cambodia: Risk Assessment." <https://globaledege.msu.edu/countries/cambodia/risk>

projects, which provides an opportunity to profit from building and operating renewable projects.

**However, general policy and regulatory risks remain high.** Low electricity tariffs and undeveloped regulatory framework are still main barriers for the private sector to invest in utility-scale renewable energy projects.

## 2.1.6 KENYA

Regulatory support for clean energy in Kenya, combined with high revenue attractiveness, make it an attractive destination for clean energy investment in sub-Saharan Africa.

While it is one of the world's most dynamic energy access markets, most clean energy in Kenya is equity-driven at the local level, with international investors, foundations and funds playing a growing role.

**Access to debt financing and local currency financing is a significant issue in Kenya,** reflected in the high average cost of debt and scarcity of local currency instruments, particularly for SMEs.<sup>112</sup>

**Off-taker and revenue volatility risks in Kenya are relatively low, with guarantees still important for accessing debt financing.** A strong distributed generation market, ongoing market liberalization, and strong policy frameworks governing the transition from feed-in-tariff to tenders and structuring of PPAs supported by government-backed guarantees, particularly for larger projects, are increasingly addressing the issues related to off-taker risk.<sup>113</sup> Kenya's geothermal feed-in-tariff, in combination with a government guarantee and MIGA's guarantee on equity, helped to make the Olkaria III project the first privately funded and developed geothermal project in Africa.<sup>114</sup>

**The ongoing electoral instability and unresolved internal political divisions and administrative barriers may deter future investment if they affect the government's perceived ability to fulfil guarantees.** The country ranks 129<sup>th</sup> (score 20.44) on the Trading Economic index looking at the credit worthiness of a country using forward looking macro-economic model, and 6/7 on OECD's country risk score.<sup>115</sup> The use of guarantees by the government, while addressing off-taker risk, transfers and concentrates risk from to the political sphere, heightening investors' exposure to adverse political developments. The 900MW in planned solar capacity will require high risk appetite and patient capital before investment returns are realized, driven partly by difficulties in securing large plots of land for solar arrays.

<sup>112</sup> Sustainable Energy for All. 2017. "Energizing Finance."

<sup>113</sup> ClimateScope. 2016. "Kenya."

<sup>114</sup> Micale, V., C. Trabacchi and L. Boni. 2015. "Using Public Finance to Attract Private Investment in Geothermal: Olkaria III Case Study, Kenya." [http://climatepolicyinitiative.org/wp-content/uploads/2015/06/150601\\_Final\\_Olkaria\\_ForWeb.pdf](http://climatepolicyinitiative.org/wp-content/uploads/2015/06/150601_Final_Olkaria_ForWeb.pdf)

<sup>115</sup> Country risk includes transfer and convertibility risk and cases of force majeure such as war, expropriation, revolution, civil disturbance, floods and earthquakes.

**Kenya's ambitious targets on geothermal energy, may require additional support on the coverage of resource risk, particularly at the early stages of drilling.** The government-run Geothermal Development Company (GDC) assumes resource appraisal and exploration risk before opening up locations to private investment, potentially reducing investors' capital costs by 15%. However, since this effectively just transfers offtaker risk onto state political and regulatory actors, more effort should be made to attract private engagement during the exploration stage of project development.<sup>116</sup>

## 2.1.7 UGANDA

**Remuneration in Uganda is generally attractive for renewable energy investment, although the market for mid-scale solution may be limited.** The clean energy sector in Uganda is growing – IPPs already make up 58% of generation. Off-grid and micro-grid solutions are attractive investments in combination with mobile payment services, and the recent boost to the feed-in-tariff, along with standardized PPAs, has further improved the investment environment.<sup>117</sup> The mid-term market for small-scale on-grid projects is however minimal, as there will likely be significant overcapacity once the additional 600MW hydro power comes online.<sup>118</sup>

**Perceived political and regulatory risk is significant in Uganda.** Given a relatively short history of clean energy investment and corresponding lack of institutionalization, political changes could easily place expectations of future progress at risk, while ensuring administrative capacity can keep up with the regulatory framework for clean energy is an ongoing challenge. Uganda's existing Bujagali hydro plant required political risk insurance and partial risk guarantee to raise adequate financing and engage private equity investors in the development of the plant.<sup>119</sup>

**Large-scale hydro – on which the country relies on - is accompanied by significant social and technical barriers,** related to the social and economic impacts of construction, as well high cost of power and exposure to reduced generation due to low water levels (as seen in Zambia).<sup>120</sup>

**As with other countries in the region, access to affordable capital, particularly debt is challenging,** both in terms of difficulty in access financing, and level of interest rates. Credible

<sup>116</sup> Micale, V., P. Oliver and F. Messent. 2014. "The Role of Public Finance in Deploying Geothermal: Background Paper." Climate Policy Initiative. <https://climatepolicyinitiative.org/wp-content/uploads/2014/10/Geothermal-Background-Final.pdf>

<sup>117</sup> ClimateScope. 2016. "Uganda."

<sup>118</sup> REN21. 2017. "Global Status Report."

<sup>119</sup> Frisari, G. and V. Micale. 2015. "Risk Mitigation Instruments for Renewable Energy in Developing Countries: A Case Study on Hydropower in Africa." Climate Policy Initiative. <https://climatepolicyinitiative.org/wp-content/uploads/2015/07/Risk-Mitigation-Instruments-for-Renewable-Energy-in-Developing-Countries-%E2%80%93-A-Case-Study-on-Hydropower-in-Africa.pdf>

<sup>120</sup> Ibid.

plans are in place to expand urban and rural electrification with credit enhancements provided by the internationally-backed Energy Credit Capitalization Company.<sup>121</sup>

## 2.1.8 RWANDA

**Rwanda's policy environment is relatively strong, with clear government support for renewable energy.** Options available to developers include standardized tender and PPA processes, unsolicited proposals, tax breaks, discretionary pricing, mini-grid innovation support, an expanded feed-in-tariff and backing from international donors. The distributed resources framework is robust, and the power sector is seeing improvements. Despite considerable progress on governance and positive growth, the business environment and political-economic outlook are "very uncertain", corporate financial information is still scarce and the regional security situation is fragile.<sup>122</sup> Rwanda is ranked 50<sup>th</sup> (of 176) on Transparency International's Corruption Perception Index.<sup>123</sup>

**Access to capital remains limited**, with limited potential market size and poor availability of local currency capital being contributing factors. No new investment was recorded in 2015 despite the country's strong enabling framework for both distributed and centralized energy.<sup>124</sup>

**Off-taker risk is still significant**, owing in part to continued subsidization of electricity prices harming the creditworthiness of the national utility.

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<sup>121</sup> ClimateScope. 2016. "Uganda."

<sup>122</sup> GlobalEDGE. 2017. "Rwanda: Risk Assessment." <https://globaledge.msu.edu/countries/rwanda/risk>

<sup>123</sup> U.K. Department for International Trade. 2017. "Overseas Business Risk – Rwanda." <https://www.gov.uk/government/publications/overseas-business-risk-rwanda/overseas-business-risk-rwanda>

<sup>124</sup> ClimateScope. 2016. "Rwanda."



### 3. Annex 3: Methodology for Blended Finance Coverage Analysis

Past experiences in blended finance initiatives give us valuable insights into how blended finance instruments have typically been structured, and what are the areas for future improvements. To understand how blended finance has been deployed to date in clean energy, we researched 25 initiatives in-depth, supplementing these with additional clean energy blended finance initiatives from Convergence's database, for a total of 74 initiatives. In addition, we developed case studies of several initiatives (see Annex 4) and interviewed a number of investors from the public and private sectors.

All the initiatives covered here focus on clean energy, and in some cases energy efficiency as well. Given some of the overlaps between the two, we have also included several energy efficiency-focused initiatives of particular relevance to the clean energy sector. Within clean energy, some primarily focus on decarbonization, while others place more emphasis on energy access. Some initiatives focus on specific countries or regions, while others are global. The data collected here is focused on developing countries divided into low income, lower-middle income or higher-middle income according to World Bank classifications. Initiatives are further classified by the blending instrument(s) they employ: concessional debt, concessional equity, guarantees or insurance, and grants.

**Initiatives also make decisions about the “level” at which to blend finance.** Blending can occur at the project level, in which public and private capital is blended within a single project or company's financial structure. Blending can also occur at the fund or facility level, in which public and private investors pool resources to be invested in multiple projects or companies. Blending can also occur in funds that in turn invest in other funds (“fund of funds”). Blending can occur at an institutional level, in which a long term or permanent institution is set up, or modified, to blend finance, thereby mainstreaming the use of blended finance. Finally, public support for project preparation and intermediaries has also been used as a way to leverage private investment by addressing specific barriers, especially information gaps. The Table below identifies example initiatives in clean energy that correspond to each of these levels.

Level	Examples
Project Preparatory Support & Intermediaries	Africa Clean Energy Facility, U.S-India Clean Energy Facility, Convergence, Aligned Intermediary, The Lab, PRIME Coalition (U.S.)
Project/Corporate	Ouarzazate Concentrated Solar Plant, La Ventosa wind farm, Lake Turkana Wind Project
Publicly-Managed Facilities	China Utility-Based Energy Efficiency Finance Program, IFC Managed Co-Lending Portfolio Program
Public-Private Funds	Climate Investor One, Danish Climate Investment Fund, Asia Climate Partners
Fund of funds	GEEREF, GEEREF Next, Catalyst
“Mainstreaming”	e.g., Green Investment Banks or Facilities; Catalytic Finance Initiative



Each initiative is classified by the specific risks/barriers it is designed to address. In line with the preceding section, these are grouped into political risks (political, regulatory and policy risk), commercial risks (upfront costs, currency risk and offtaker risk), and technical and physical risks (technological and exploration risk). We have added a fourth category under 'other investor barriers' pertaining to information gaps, since many initiatives seek to improve enabling conditions by increasing the information available to market participants, e.g. helping domestic commercial banks assess creditworthiness of borrowers for rooftop solar projects.

Finally, we collected data on the specific investors involved in each initiative. On the public side, they are separated into multilateral development banks; national development banks & development finance institutions: national governments; bilateral aid agencies; multilateral climate funds; and philanthropic foundations. On the private side, the categories (in descending order of risk appetite) are venture capital & private equity; hedge funds & asset managers; corporations; commercial banks; insurers; and pension funds.

For the 25 initiatives examined in detail (see below), we have identified the capital stack and returns structure of each initiative where data availability permits, as well as its proposed rationale for removing concessionality over time. Data on private sector leverage is sporadic and non-standardized, but can identify the order of magnitude of leverage. As discussed in the report, leverage is a complex concept and high values do not necessarily imply that private sector financing is additional to the investment that would have occurred without the blended finance instrument.

### **Initiatives surveyed in depth:**

Armstrong SE Asia Clean Energy Fund  
 Africa Clean Energy Finance (ACEF)  
 Asia Renewable Energy Fund (AREF)  
 Canada Climate Change Program  
 China Utility-based Energy Efficiency Program (CHUEE 1 & 2)  
 China Utility-based Energy Efficiency Program for SMEs (CHUEE 3 SME)  
 Climate Investment Funds (CIF) - Clean Technology Fund (CTF)  
 Climate Investment Funds (CIF) - Scale-up Renewable Energy Program (SREP)  
 Climate Investor One (CIO)  
 Climate Public Private Partnership (CP3) - Asia Climate Partners (ACP)  
 Climate Public Private Partnership (CP3) - Catalyst Fund  
 Danish Climate Investment Fund (KIF)  
 Energy Access Ventures (EAV)  
 Energy Savings Insurance  
 Global Climate Partnership Fund (GCPF)  
 Global Energy Efficiency and Renewable Energy Fund (GEEREF)  
 GEEREF NeXt

IFC MCPP Infrastructure  
Loans4SME  
Long Term FX Risk Management  
Renewable Energy Asia Fund I (REAF I)  
Renewable Energy Asia Fund II (REAF II)  
US-India Clean Energy Finance (USICEF)  
World Bank IDA Private Sector Window  
Ouarzazate CSP I  
Sub National Climate Fund (SnCF)

## 4. Annex 4: Case Studies of Blended Finance Initiatives in Clean Energy

### 4.1 Project Preparation Facility: Africa Clean Energy Finance (ACEF)<sup>125,126,127</sup>

**Rationale:** Small-scale entrepreneurs in challenging regulatory and political environments in Africa face high development costs, lack access to financing, and experience shortages of local managerial and technical expertise.

**Structure:** Project preparation grants can improve project viability by helping to meet upfront planning costs, prior to seeking investment on commercial terms. ACEF is a USD 20 million U.S. government-funded project preparation facility offering grants to cover non-operational expenses for early-stage clean energy access projects and companies. The objective is to prepare projects to receive OPIC investment to scale up. ACEF is active in Ethiopia, Kenya, Morocco, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania and Uganda. Leverage of public and private funding (including multiplier effects) is estimated at 75x the initial investment, although public funding refers to pre-allocated OPIC investment and should not necessarily be considered additional.

**Results:** ACEF projects have currently raised USD 398 million in investment, with an overall target of USD 1 billion. The model has been replicated in India as U.S.-India Clean Energy Finance initiative.

**Opportunities:** Like most project preparation facilities, ACEF is a grant-based model. Future iterations could develop financially sustainable models for project preparation, including models that could be fully privately financeable. Future models could also seek to leverage private investment, rather than just commercial public investment.

### 4.2 Project Level: Lake Turkana Wind Farm, Kenya<sup>128,129,130</sup>

**Rationale:** Building large-scale renewable energy generation capacity in Kenya faced several barriers. Primary amongst these were the absence of sufficient local capital resources, a viability gap between expected and required electricity revenues, off-taker risks linked to political uncertainty in the Kenyan government, and a lack of transmission infrastructure.

**Structure:** Lake Turkana is a USD 870 million, 310MW wind farm, the largest such project in Africa and largest single infrastructure investment in Kenya to date. Concessional debt and equity instruments, supplemented by an off-taker guarantee (AfDB and Kenyan government) and

<sup>125</sup> Wiedemann Associates, Inc. 2016. "Evaluation of the United States-Africa Clean Energy Finance Initiative (US-ACEF)". <https://www.state.gov/f/evaluations/all/270645.htm>

<sup>126</sup> OPIC. 2013. "U.S.-Africa Clean Energy Finance Initiative (ACEF)". <https://www.opic.gov/sites/default/files/files/ACEF%20One-Page%202013%20final.pdf>

<sup>127</sup> Morton, J. 2015. "US-Africa Clean Energy Finance Initiative - Supporting Renewable Energy to Power Africa". The OPIC Blog. <https://www.opic.gov/blog/renewables/u-s-africa-clean-energy-finance-initiative-supporting-renewable-energy-to-power-africa>

<sup>128</sup> Senelwa, K. 2014. "\$250m for Lake Turkana wind power project." <http://www.theeastafrican.co.ke/business/-/2560/2348230/-/itepg9z/-/index.html>

<sup>129</sup> Project Finance International. 2015. "Lake Turkana gets up to speed." <http://www.pfie.com/lake-turkana-gets-up-to-speed/21178007.fullarticle>

<sup>130</sup> Aldwych International. 2014. "Lake Turkana Wind Power Project". Seminar on Sustainable Energy Investments in Africa, Copenhagen, 24-25 June 2014. <https://old.danwatch.dk/wp-content/uploads/2016/05/Aldwych-Presentation-on-LTWP-2014.pdf>

loan guarantee (Danish EKF), were needed to close the viability gap between required and expected revenues, and catalyze the remaining financing from private sources. All electricity produced by the project will be purchased under a 20-year PPA signed with utility KPLC and guaranteed by the AfDB and Kenyan government. The latter also assumes liability for political risk. The capital structure includes subordinated debt and concessional equity, while the Danish export credit agency EKF guarantees AfDB and EIB loans.

**Investors:** Public investors are AfDB (also providing breach-of-contract insurance), EIB, FMO, Proparco, ICCF, EADB, OPIC and DEG (senior and subordinated debt), and Finnfund and Norfund (equity). Private investors are Nedbank and Standard Bank (commercial bank guarantee providers), Triodos (senior debt), and KLP Norfund, IFU, Aldwych, KP&P, Vestas and Sandpiper (equity). The lead deal arrangers were AfDB, Nedbank and Standard Chartered.

**Results:** The project began generating electricity in 2016, although was unable to connect to the grid owing to delayed construction of transmission lines. In September 2017, the Kenyan government agreed to pay the developers USD 56 million in capacity charges in compensation, to be financed by a monthly surcharge passed on to consumers, beginning in May 2018.

**Opportunities:** Although Lake Turkana is highly context-specific and benefited from a range of concessional instruments, as well as the government's ability and willingness to assume off-taker and political risk, it demonstrates that blending can support large renewable energy infrastructure projects in developing countries. The instrumental role of guarantees may inform blending approaches for similar projects in the future aiming to reduce the concessional element.

### 4.3 Corporate: Energy Access Ventures<sup>131,132</sup>

**Rationale:** Small-scale clean energy businesses in rural areas of low-income countries in sub-Saharan Africa cannot access financing due to underdeveloped capital markets, and require project preparation support to achieve scale and profitability. Developers face comparatively large upfront compliance costs.

**Structure:** Energy Access Ventures (EAV) is a \$61m private equity fund, providing flexible equity in the range of \$0.5-4m for early-stage off-grid renewable energy generation enterprises in predominantly low-income countries in sub-Saharan Africa with low energy access, and helping investees secure grant support. It also helps secure technical assistance in the form of personnel, impact assessments and compliance advice. Aims to grow portfolio companies' strategy and team, raise further funding and develop exit plans. The target IRR is 25% and returns are distributed *pari passu*.

<sup>131</sup> Africa-EU Renewable Energy Cooperation Programme. n.d. "Energy Access Ventures - Funding Database." <https://www.africa-eu-renewables.org/funds/theenergy-access-ventures-funde>

<sup>132</sup> Schneider Electric. 2015. "Energy Access Ventures Fund launched: boost for access to energy in Sub-Saharan Africa." [http://www2.schneider-electric.com/documents/press-releases/en/shared/2015/03/20150302\\_PRF\\_AfricaEnergyAccessFund\\_EN.pdf](http://www2.schneider-electric.com/documents/press-releases/en/shared/2015/03/20150302_PRF_AfricaEnergyAccessFund_EN.pdf)

**Investors:** Private investors are CDC Group, DFID, EIB, FISEA-PROPARCO, OFIC and AFD-FFEM. The only private investor is electricity and power company Schneider Electric, which also offers skilled personnel to assist with installation and operation.

**Results:** EAV closed in February 2015, and holds investments in d.light, Off Grid Electric (Tanzania), PEG (Ghana), PayGo Energy (Kenya), SunCulture and InspiraFarms. Private sector leverage is low, confined to EUR 16.5m from Schneider Electric, or 30% of the fund total.

**Opportunities:** Several interviewees noted the need for blended equity, especially at early stages, for companies offering off-grid electricity products.

#### 4.4 Publicly-Managed Facility: China Utility-focused Energy Efficiency Program (CHUEE)<sup>133,134,135,136,137,138,139</sup>

**Rationale:** The energy efficiency and sustainable energy finance markets for SMEs and ESCOs in China have insufficient access to commercial bank financing. Commercial banks' unwillingness to lend to small-scale sustainable energy finance projects was due to a lack of market knowledge and risk assessment capacity.

**Structure:** CHUEE aimed to improve the marketing of loans, diversify banks' portfolios and lower risk-assessment costs, focusing on SMEs to maximize additionality. CHUEE I/II was a USD 783 million IFC-China facility originally conceived to support small-scale (USD 3-5 million) energy efficiency investments in China through commercial bank partners. It replicated a model first tested by the IFC and GEF in Hungary. The banks lent at commercial rates, supported by a public guarantee covering USD 587 million (75%) of losses. Estimated leverage of 45-50x includes indirect multiplier effects from bank lending, and therefore should be seen as the upper bound.

<sup>133</sup> World Bank. n.d. "China - Utility-Based Energy Efficiency Finance (CHUEE) Program".

<http://documents.worldbank.org/curated/pt/943841468024543248/pdf/761070BRI0IFC000Box374367B00PUBLIC0.pdf>

<sup>134</sup> IFC. 2013. "Terminal Evaluation of China Utility Based Energy Efficiency Program (CHUEE) - Executive Summary of Evaluation for Public Disclosure".

<http://www.ifc.org/wps/wcm/connect/0083ab004602caacade5bd9916182e35/Terminal+Evaluation+of+CHUEE.pdf?MOD=AJPERES>

<sup>135</sup> UNFCCC. 2014. "IFC China Utility-Based Energy Efficiency (CHUEE) Program".

[https://unfccc.int/secretariat/momentum\\_for\\_change/items/8373.php](https://unfccc.int/secretariat/momentum_for_change/items/8373.php)

<sup>136</sup> IFC. n.d. "China Utility-based Energy Efficiency Finance Program (CHUEE)".

<http://www.ifc.org/wps/wcm/connect/0f680e004a9ad992af9fff9e0dc67fc6/Chuee+brochure-English-A4.pdf?MOD=AJPERES>

<sup>137</sup> IFC. 2015. "China Utility-based Energy Efficiency Finance Program (CHUEE) - About Us".

[http://www.ifc.org/wps/wcm/connect/RegProjects\\_Ext\\_Content/IFC\\_External\\_Corporate\\_Site/Home\\_CHUEE/About+Us/](http://www.ifc.org/wps/wcm/connect/RegProjects_Ext_Content/IFC_External_Corporate_Site/Home_CHUEE/About+Us/)

<sup>138</sup> IFC. 2014. "Mid-term Evaluation of the CHUEE 3 Program - Executive Summary of Evaluation".

<http://www.ifc.org/wps/wcm/connect/f622648047c8d650acdafad299ede9589/Mid-term+Evaluation+of+the+CHUEE+3+Program.pdf?MOD=AJPERES>

<sup>139</sup> Von Hindenburg, H. and S. Jweied. 2013. "IFC, Chinese Bank Launch Program to Reduce Climate Change through the Private Sector". 4-traders. <http://www.4-traders.com/news/IFC-International-Finance-Corporation-IFC-Chinese-Bank-Launch-Program-to-Reduce-Climate-Change--16746388/>

**Investors:** Public investment was sourced from IFC, China, Finland, Norway and the GEF. Partner banks were Industrial Bank, Bank of Beijing and Shanghai Pudong Development Bank.

**Results:** Partner banks developed USD 170 billion in sustainable energy portfolios, with two of them experiencing no defaults. After underestimating under-funding in the market, the initial program was expanded from USD 533 million to 783 million and pivoted to focus on emissions reductions over its original aim of reducing SME market barriers. Evaluators have pointed to an excessive focus on large-scale investments limiting the program's additionality. It has been replicated in Turkey.

**Opportunities:** The program's successor, the USD 558 million CHUEE 3, refocused lending on SMEs to increase additionality and enhance access to finance for smaller players. CHUEE 3 reduces guarantees to 50% of losses and adds an advisory facility. The mid-term assessment indicated the advisory facility was important to partner banks in increasing internal capacity, and found the 50% guarantee and USD 3 million credit limit to be too low, recommending an increase to 100% and USD 6 million respectively. The program has been replicated in the Philippines (as the Sustainable Energy Finance programme) and may be extended towards Chinese policy and development banks.

#### 4.5 Privately-Managed Fund: Climate Investor One (CIO)<sup>140</sup>

**Rationale:** Renewable energy projects confront a range of barriers to accessing finance on commercial terms across the project life-cycle. These include access to financing to cover development costs; equity financing at the construction stage; and the ability to refinance efficiently once the project is in operation.

**Structure:** CIO offers revolving life-cycle support through three inter-lined funds, designed to address the barriers specific to each of these stages while meeting investors' needs at the construction and refinancing stages. It is managed by Climate Fund Managers. The Development Fund meets up to 50% of development costs, funded by development loans. The Construction Fund finances up to 75% of capital costs with equity. Investors in this fund select from three tranches: first-loss (20%), subordinated (40%) and senior with credit guarantees (40%). The Refinancing Fund offers investors first refusal on up to 50% of long-term refinanced debt after projects enter into commercial operation. CIO invests in countries with BB sovereign debt ratings and below in Asia, Africa, India and Latin America.

**Investors:** The public sector investors are FMO (including the start-up capital), the Dutch government, USAID and the Dutch Export Credit Agency Atradius (which provides the Construction Fund guarantee). Private investors currently include Aegon Asset Management, Climate Fund Managers, NWB Bank, Sanlam Investment Holding, KLP Norway, and the Windsor and Maidenhead Pension Fund.

**Results:** CIO first closed at USD 412 million in June 2017. The fund-level public to private financing ratio is to date approximately 1:1.71. Climate Investor One required three years to

<sup>140</sup> Global Innovation Lab for Climate Finance. n.d. "Climate Investor One: About".

<https://www.climatefinancelab.org/project/fmo-climate-development-finance-facility/>

Global Innovation Lab for Climate Finance. 2014. "Climate Investor One: Overview".

<https://climatefinancelab.org/wp-content/uploads/2014/08/Climate-Investor-One-Overview.pdf>

transition from concept through fund design and capital raising to first close, whilst building an investment pipeline and alignment across the wide range of public, private and DFI capital sources. This process required start-up capital in excess of USD3 million. Aligning the needs of public and private investors was a considerable challenge, although the first close was very successful and saw higher institutional investor interest in the Construction Fund higher risk equity tranche than initially expected.

**Opportunities:** Climate Fund Managers have the ambition to scale-up CIO in size and breadth, including through deployment in other sectors – water, landscape, oceans and cities – to up to USD 50 billion in scale. The fund managers claim that, in addition, replication of the model to third parties could boost its impact to USD 500 billion.

#### 4.6 Fund-of-funds: Global Energy Efficiency and Renewable Energy Fund (GEEREF)<sup>141,142,143,144</sup>

**Rationale:** First-time private equity funds and fund managers can face difficulties raising debt or equity capital if the fund managers lack a track record in the clean energy sector.

**Structure:** GEEREF aims to scale up low-risk, proven-tech clean energy infrastructure through equity financing in first-time private equity funds by crowding in debt financing (demonstration effect, investment environment risks). GEEREF is a fund-of-funds leveraging private sector financing to invest in renewable energy and energy efficiency funds in Africa, Asia, Latin America and the Caribbean. Managed by the EIB, the fund is EUR 222 million in size, with 1:1 public/private blending. The risk waterfall structure offers upside profits to private investors while protecting public investors from disproportionate losses. Fund-level leverage is estimated at 8x, with another 9.5x at project level (although the project level leverage estimate includes multiplier effects).

**Investors:** Public investors are the EU, Germany, and Norway (EUR 112 million), and European Investment Bank (EUR 10 million). Private investors are Catholic Super, Portland Holdings, Imprint Capital, L&P, Sainsbury and Christian Super (EUR 100 million).

**Results:** GEEREF has made 13 anchor equity investments in EUR 50-200 million funds with a regional focus and strong deal pipelines, prioritizing countries with relatively strong renewable energy enabling environments. This has helped establish standalone private equity firms now managing multiple funds, notably Berkeley Energy, MGM, and Inspired Evolution, as well as a track record in the sector in multiple countries.

**Opportunities:** The proposed scaled-up EUR 750 million follow-on fund, GEEREF NeXt, offers the same returns structure but reduces concessional funding to one third, with EUR 250 million in junior equity approved by the GCF and the remainder in senior equity sought from private

<sup>141</sup> European Investment Bank, GEEREF and European Investment Fund. 2016. "GEEREF Impact Report 2015".

<sup>142</sup> GEEREF. 2017. "GEEREF Portfolio". <http://geeref.com/portfolio/>

<sup>143</sup> European Investment Bank. n.d. "GEEREF Risk Waterfall". PowerPoint Presentation.

<sup>144</sup> European Investment Bank. 2017. "Funding Proposal FP038 Version 1.1: GEEREF NeXt - Decision B.16/02". [https://www.greenclimate.fund/documents/20182/574760/Funding\\_Proposal\\_-\\_FP038\\_-\\_EIB\\_-\\_Multiple\\_Countries.pdf/2cfaf3b1-1e3d-4bf8-a02a-30d954f2dd80](https://www.greenclimate.fund/documents/20182/574760/Funding_Proposal_-_FP038_-_EIB_-_Multiple_Countries.pdf/2cfaf3b1-1e3d-4bf8-a02a-30d954f2dd80)

investors and EIB. While retaining a focus on anchor investments, GEEREF NeXt may also invest directly in its funds' renewable energy infrastructure projects.



## 5. Annex 5: Recently Developed Blended Finance Initiatives

The list below is not comprehensive but seeks to highlight some initiatives that were described in interviews and/or have been endorsed by the members of the Global Innovation Lab for Climate Finance and its sister Labs in India and Brazil.

INITIATIVE	BARRIER(S) ADDRESSED	TYPE & MANAGER	GEOGRAPHIES	INSTRUMENT(S) USED	INVESTMENT SOUGHT	LEVERAGE AND/OR EXPECTED RETURNS
<a href="#">Renewable Energy Scale-Up Facility</a>	Access to early stage capital Construction risks	Private Fund managed by Tagus	SE Asia Latin America	Concessional loans Subordinated Equity	USD 10M for development USD 100M for construction incl. 20M public	1:2.67 fund level Net returns of 12-13%
<a href="#">Green Finance Catalytic Facility</a>	Off-taker risk Revenues attractiveness	Public facility developed by ADB for implementation by national governments	Any developing economies (currently developing in China & Kazakhstan)	Subordinated capital Credit enhancement	Unknown	Minimum 1:1-2 at the project level; further leverage at re-financing
<a href="#">DBSA Climate Finance Facility</a>	Access to capital Up-front costs	Public facility supporting DBSA Climate Finance Unit	Southern Africa	Subordinated capital (first-loss) Credit enhancement	USD 160M from DFIs and GCF	Commercial returns for private investors
<a href="#">Common Risk Mitigation Mechanism</a>	Cost of capital Scale Political risk Offtaker risk Currency risk	Public facility with country support under International Solar Alliance	Global, high solar potential developing countries	Guarantees	USD 1TN by 2030	1:10.5 project level
<a href="#">Green Receivables Fund</a>	Access to capital Development risk Liquidity risk	FIDC securitization vehicle proposed by Albion Capital & Get2C Brasil	Brazil	Concessional loans	USD 15-20M mezzanine capital	Leverage USD 1bn over ten years
<a href="#">Solar Energy Investment Trusts</a>	Access to capital Scale Lack of information Liquidity risk	Developer-managed Infrastructure Investment Trust Proposed by CleanMax Solar	India	Grants for transaction costs Credit guarantees	-	USD 1BN by 2022; 12% equity return
<a href="#">GEEREF NeXt Facility for Energy Inclusion</a>	Currency risk Regulatory risk Commercial and offtaker risk	Public fund-of-funds managed by EIB	Global, developing countries	Concessional equity Grants	USD 765M targeted	1:2 at fund-of-funds level. Est 1:7 (fund), 1:50 (project). Preferred returns.
<a href="#">Facility for Energy Inclusion</a>	High transaction costs Currency risk	Public facility with independent fund manager	Africa	Concessional loans Subordinated debt	USD 500M	Commercial returns