November 2018

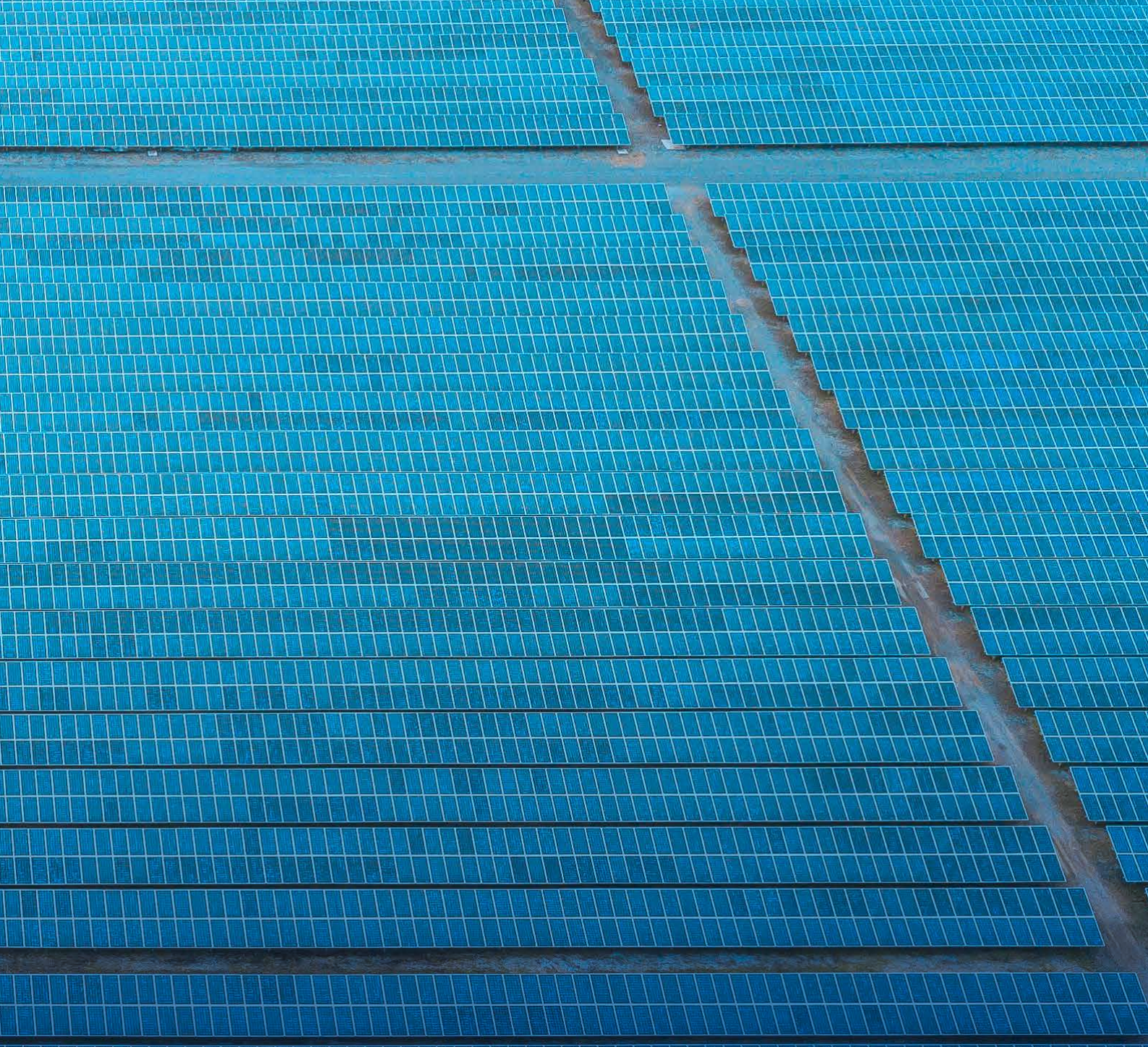
Technical note: Allianz Climate and Energy Monitor 2018

Assessing the needs and attractiveness of low-carbon investments in G20 countries

Allianz

NEW CLIMATE INSTITUTE

GERMANWATCH



The Allianz Climate and Energy Monitor is an annual publication, developed jointly by NewClimate Institute, Germanwatch and Allianz SE. The focus is on power production from renewables in G20 countries as core solutions for the decarbonization of the power infrastructure. The EU, as a supranational body, is excluded from the assessment.

The **NewClimate Institute** for Climate Policy and Global Sustainability is a German-based research institute generating ideas on climate change and driving their implementation. It undertakes research, designs policies and shares knowledge on ambition raising for preventative climate change action and sustainable development. The core expertise lies in the areas of climate policy analysis, climate action tracking, climate finance, carbon markets, and sustainable energy.

Germanwatch is an independent development and environmental organization that advocates for global equity and preservation of livelihood. They concentrate on politics and economies of the "global north" and its worldwide impacts. They work together with members, sponsors and other actors from the civil society to lobby for sustainable development. Drawing on scientific analysis they inform the public sector, undertake educational work, function as a lobbyist, and demonstrate consumers how to act according to their goals.

The **Allianz Group** is one of the world's leading insurers and asset managers with more than 88 million retail and corporate customers. Allianz customers benefit from a broad range of personal and corporate insurance services, ranging from property, life and health insurance to assistance services to credit insurance and global business insurance. Allianz is one of the world's largest investors, managing over 660 billion euros on behalf of its insurance customers while our asset managers Allianz Global Investors and PIMCO manage an additional 1.4 trillion euros of third-party assets. Thanks to our systematic integration of ecological and social criteria in our business processes and investment decisions, we hold the leading position for insurers in the Dow Jones Sustainability Index. In 2017, over 140,000 employees in more than 70 countries achieved total revenue of 126 billion euros and an operating profit of 11 billion euros for the group.

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Introduction

Achieving the goal of net zero greenhouse gas (GHG) emissions reductions during the second half of the 21st century under the Paris Agreement (UNFCCC, 2015), would require the decarbonization of energy supply, mainly through deployment of renewable energy at an unprecedented pace. This in turn signifies major business opportunities for the renewable energy-related sectors in the next decades.

A boost in investments in assets with such a long lifetime as energy infrastructure demands an investment climate that suits the preferences of long-term investors. The rationale that guides investment decisions in a country has been a topic of longstanding discussion in scholarly and policy circles. Naturally, country-level drivers are critical for an investor's decision-making. However, another layer of nuance is added by the sector- and technology-specific determinants, particularly, sector-specific policy and regulatory drivers. With climate and energy policy increasingly converging, policy and regulatory determinants for renewable energy investments are of much higher significance compared to more traditional areas of investment. Prior experience with a technology and its market maturity are other sector-specific variables that together determine the attractiveness of a country to an investor.

However, investment attractiveness presents only a part of the picture in an era of changing investor sentiments on low-carbon investing. Investors have proactively shown interest in understanding areas where investments are most needed in addition to investing in the most attractive destinations.

Against this background, Allianz SE has contracted NewClimate Institute and Germanwatch to develop an index as an information and communication tool that assesses the drivers of investment attractiveness for G20 countries and captures the investment needs for a low-carbon and climate-resilient electricity infrastructure. The 'Allianz Climate and Energy Monitor' (hereafter, 'the Monitor') aims to be a channel of communication between the investor community and policy-makers to channel investments in energy infrastructure towards global climate goals, while also indicating investment opportunities in the sector.

The coverage of the Monitor is unique as it brings together dimensions of policy, finance and markets, thus deviating from other renewable energy indices. Some other value additions of the Monitor are:

- It reflects the dynamic interaction between energy and climate policies in countries from a private investor perspective
- It balances current performance and future policy trajectory, including Paris compatibility
- It indicates investment needs for climate resilience

The Monitor covers G20 member states (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom and the United States of America) because of their defining role in the current and future trajectory of global power supply and demand and desired climate leadership. G20 countries host two-thirds of global population, contribute to nearly 80% of world GDP and producing over 80% of the global energy of which power sector forms a major proportion. The European Union as a supranational body is excluded from the assessment.

This document explains our methodological framework and approach towards developing the Monitor's 2018 results and is an update of the technical note from last year's assessment.

Conceptual framework of the Monitor

The Monitor ranks G20 member states on their relative fitness as potential investment destination for building low-carbon electricity infrastructure and provides additional information about the current and future investments needs in the sector.

Electricity infrastructure is defined as the physical infrastructure required for producing, transporting and storing electricity from fossil fuel and renewable energy sources. Of these, the Monitor's assessment scope includes renewable energy production only, excluding fossil fuels, nuclear power and large hydro[1] as well as transportation and storage infrastructure.

1 Large hydro and nuclear were omitted from the assessment due to the sustainability concerns of these technologies. The methodological scope of each category did not present the need to use a specific definition of 'large' hydro, except in policy adequacy, where a country's own definition of 'large' and 'small' was included in the assessment.

The Monitor is an index that assesses the attractiveness for renewable energy investments and provides supplementary information on the investment needs of countries.

The **investment attractiveness** of a country is assessed across five categories – the long-term and short-term policy support for climate and renewable energies (categories 1 and 2: 'Long-term Paris compatibility' and 'Policy environment for renewables'), a country's preparedness for higher shares of renewables in its grid (category 3: 'Conditions for system integration'), the in-country market maturity to build and maintain green electricity infrastructure (category 4: 'Market absorption capacity'); and the overarching country-level factors that facilitate investments and business in a country (category 5: 'General investment conditions'). Each category further includes a set of indicators (explained in the later sections).

The Allianz Climate and Energy Monitor provides additional information on the annual average **investment needs** in the power sector in G20 countries by employing a comparative approach, considering both a business-as-usual scenario and a well below 2°C compatible pathway.

Figure 1 provides an overview of the categories, indicators and proxies used to assess the different components of the investment attractiveness pillar. The detailed assessment approach and the underlying data for this pillar are discussed in in the following sections.

The subsequent steps were followed to arrive at the scores that underpin the ranking:

1. **Data treatment:** In certain instances, the collected raw data required adjustments for further assessment. This included rescaling variables on a 0-100 scale (e.g. for World Governance Indicators under 'General investment conditions' which were from -2.5 to 2.5) or unit conversions (e.g. for renewable energy targets under 'Renewable energy ambition').

2. **Addressing skewness and extreme values:** An initial review of the data revealed asymmetrical distribution (or skewness) and the presence of significantly extreme values in some indicators. We used a two-step approach to reduce the effect of outliers and skewness. For smoothening the skew, we undertook data transformation for indicators which were deemed to have large skewness. In addition, to avoid extreme values to dominate in the aggregation and normalization scheme, we saturated all indicators at the 90 and 10 percentiles. That is, the data points greater than the 90^{th} percentile are trimmed down to the 90^{th} percentile value and values smaller than the 10^{th} percentile are elevated to the 10^{th} percentile value. While we note the lowered emphasis of the trimmed values when using this approach, it is deemed necessary for the aggregation algorithm to make sense and does not change the relative position of the countries with these values. Sophisticated statistical approaches to tackle skewness and extreme values were of limited use due to the small sample size.

3. **Normalization:** Next, indicators were normalized to make them comparable to each other for aggregation. Following the OECD Guidebook on constructing composite indicators (Nardo et al., 2008); each indicator was normalized as follows:

   $$X_{i(nom)} = ((X_i - X_{worst}) / (X_{worst} - X_{best})) * 100$$

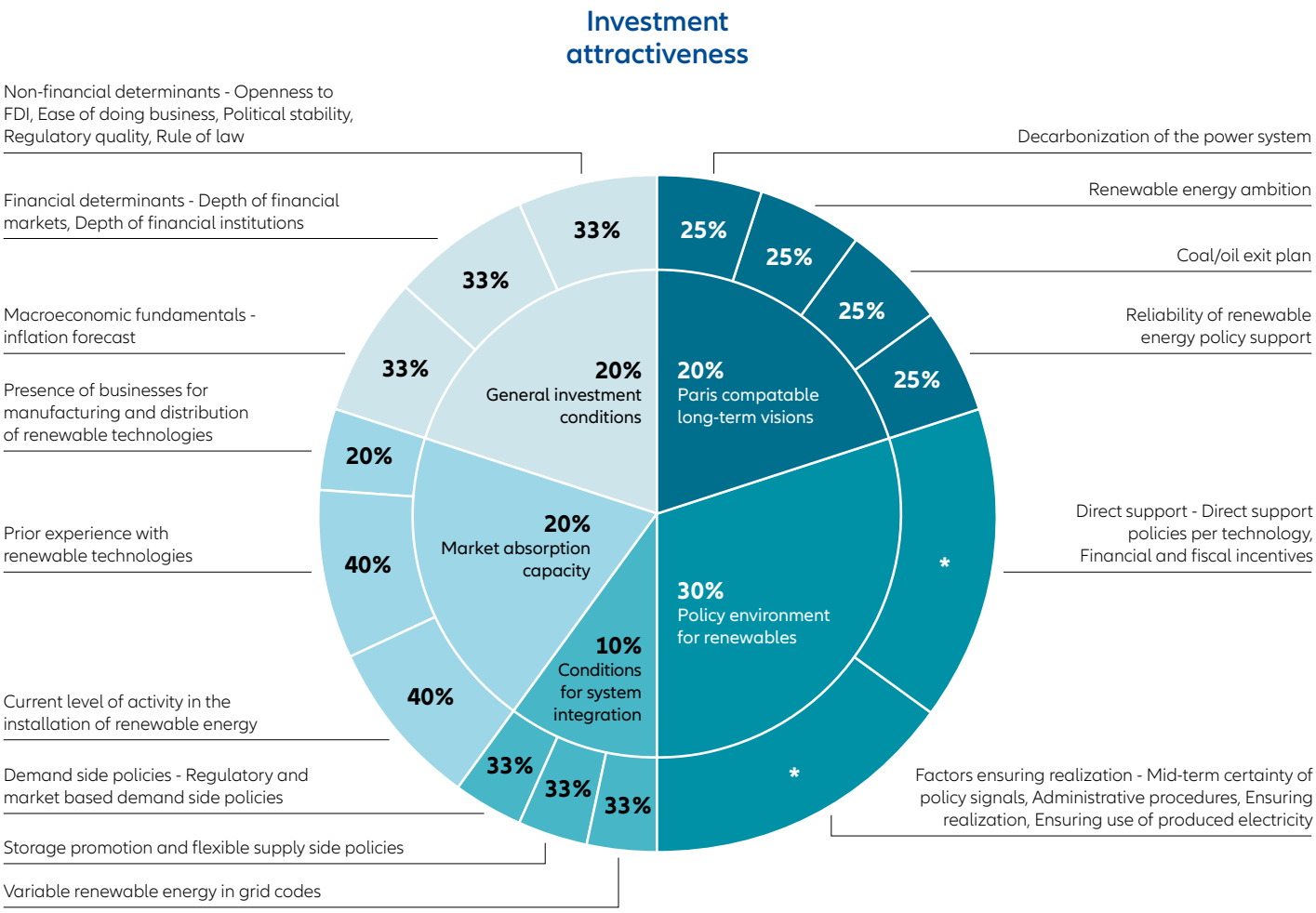
   where, $X_{i(nom)}$ is the normalized value of an indicator *i*

   In this manner, scores lie between the best score in the sample (100) and the worst score in the sample (0) for each normalized indicator.

4. **Weighting and Aggregation:** Following normalization, we use a weighting scheme to aggregate the scores of indicators to arrive at the pillar scores. For investment attractiveness, expert judgement is used to assign weights to indicators for arriving at category scores, which are then weighed equally to arrive at the pillar scores. The rationale for weighting is explained in the subsequent sections.

5. **Rating and ranking:** To improve the representation of final results, the final scores for the investment attractiveness pillar were represented in five-point ratings – very low (countries with a score between 0 up to 20), low (21-40), medium (41-60), high (61-80), very high (81-100).

FIGURE 1 Overview of the composition of the Monitor



* Indicators 'Direct policy support' and 'Factors ensuring realization' are multiplied.

Methodological changes

The 2018 Monitor has made several changes to the 2017 methodology, for the following reasons:

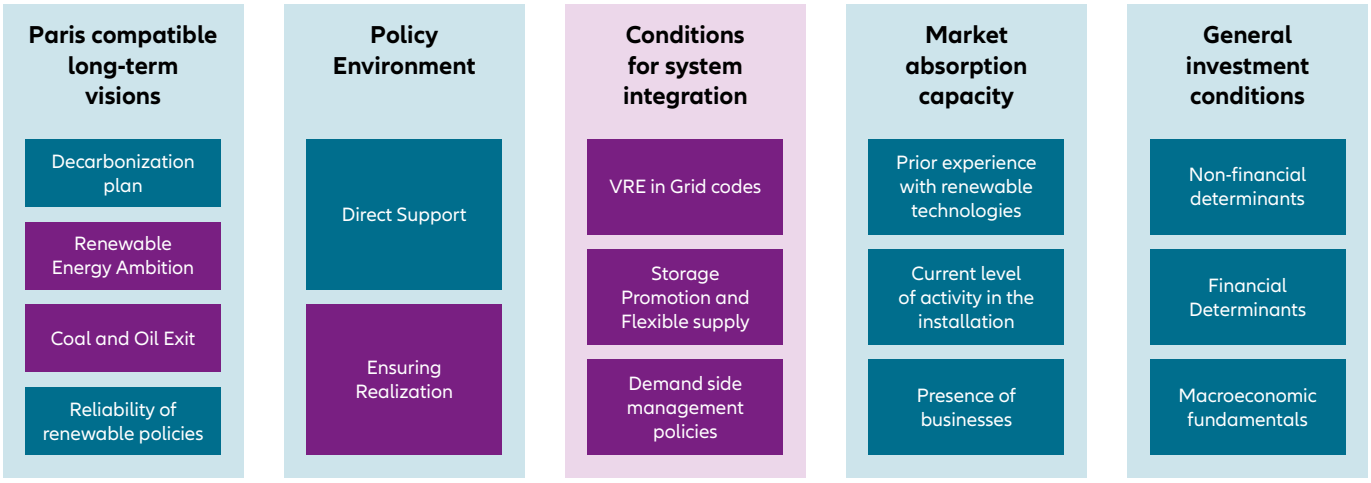
- Being able to more strongly reflect recent trends and political developments
- Improving clarity of the Monitor
- Strengthening the branding of the Monitor

These changes include:

- Focus more strongly on the 'investment attractiveness' pillar for more clarity and communication purposes
- Illustrate 'investment needs' as additional information only
- Integrate more forward-looking elements to bring in more dynamic elements
- Include explicit Paris compatibility criteria
- As the share of variable renewable energy in the grid continues to grow, include an additional category on system integration

Figure 2 provides an overview of the main methodological changes to the 2018 Monitor. *Purple* boxes or columns show new indicators or categories, while *turquoise* colored boxes and columns show existing indicators or categories with very little changes only. Further details on the new indicators and categories are explained in the subsequent sections of this methodological note.

FIGURE 2 Main methodological changes - Allianz Monitor 2018



Renewable Energy Investment Attractiveness

Category 1: Paris compatible long-term vision

This category assesses the ambition of G20 member states towards full-decarbonization of the power sector. It assesses countries' performance on long-term plans to decarbonize, ambition of renewable energy targets to facilitate such decarbonization, parallel efforts to phase-out coal (and oil) and the reliability of political support to renewables.

This category is a new addition to the Monitor this year. IPCC's 1.5-degree assessment report points towards the need for a dramatic shift in thinking about the urgency of climate change. Mid-century is a clear benchmark for the world to achieve net-zero emissions (IPCC, 2018). For the power sector, this translates into an urgent push to move away from fossil fuel-based generation and accelerate the expansion of renewables, i.e. full decarbonization of the power sector.

The category aims to inform investors on whether countries have adopted a Paris compatible long-term vision for the power sector. For doing so, it brings together indicators that provide information on the plans and ambition of G20 member states to decarbonize their power systems and plans to phase-out dependence on coal and oil-based power. More so, the reliability of political support to renewables is also covered to bring in the element of certainty that countries will follow-through on their plans.

The four analytical elements assessed to comment on the Paris compatibility of a country's long-term vision are as follows:

1. Decarbonization plan for the power system
2. Renewable energy ambition
3. Coal and oil exit plans
4. Reliability of renewable policies

The category weighs 20% in the overall assessment.

Assessment approach

For all indicators, except 'Reliability of renewable policies', the assessment approach consists of a qualitative assessment with a benchmarking approach for scoring using both quantitative and qualitative data. The method defines a set of indicators for a desired outcome, in this case, a support framework that facilitates full decarbonization of the power sector by the timeframe needed for limiting global warming to 1.5°C degrees, and scores them based on predefined scoring benchmarks. The indicator scores are aggregated using a weighting scheme to obtain their value. Equal weighting was applied to keep the approach reasonably simple.

The weighted value of all policy incentives is, therefore, determined as follows:

$$indicator_{total} = \sum_{i=1}^{n} (score_i \, x \, weight_i) \qquad (1)$$

Where i = indicator and n = number of indicators

The detailed assessment approach is elaborated in Table 1 and explained in the next section.

TABLE 1 Composition of 'Paris compatible long-term vision' category

Indicator	Proxies	Assessment approach	Weight
1.1 Decarbonization plan for the power system	– Mid-century mitigation strategies submitted to UNFCCC – Renewable energy targets in policies and plans	**100:** A binding, ambitious and concrete strategy for power sector decarbonization exists **75:** A binding and ambitious long-term transition strategy exists but lacks concreteness **50:** A binding strategy in place but lacks both ambition and concreteness **25:** No 2050 plan but a post-2020 RE strategy exists **0:** Policy cliff-edge after 2020 (RE strategy)	**25%**
1.2 Renewable energy ambition	– Renewable energy target values	**100:** 100: target on trajectory towards full decarbonization in 2050 **1-99:** scaled **0:** equal or lower than reference development of 1% increase per year or no target	**25%**
1.3 Coal and oil exit plans	– Agreed plans on coal and/or oil phase-out	**100:** A coal and/or oil phase-out date is agreed **50:** No agreement on specific date for coal and/or oil phase out, but country has been vocal about its commitment to phase out (e.g. in international coalitions such as powering-past coal alliance) **0:** Continued role of coal/oil-based generation	**25%**
1.4 Reliability of renewable policies	– Fluctuations in support to renewable energy – Party consensus concerning ambitious renewable energy policies	Fluctuation of support measured by standard deviation of CCPI Energy Scores 2012-2018 on a 0 – 100 scale *multiplied* with CCPI Energy Scores 2012-2018 Expert judgment on party consensus regarding ambitious renewable energy policies (also on a 0 - 100 scale)	**12,5%** **12,5%**

Indicators and scoring methods

1. Decarbonization plan for the power system

This category checks if countries have already defined long-term plans for the decarbonization of the power system and if so, assesses their degree of 'bindingness', 'ambition' and 'concreteness'.

To assess the 'bindingness' of plans, we collected information on mid-century strategies submitted to the UNFCCC. Information on any legally agreed strategies/plans which may not have been submitted to the UNFCCC was also collected. We note that studies exploring long-term decarbonization were not considered to be binding plans.

The 'ambition' and 'concreteness' of strategies considered 'binding' is checked through a manual textual analysis. For 'ambition", mention of *full-decarbonization of the power* sector in the strategy is assessed, and if not mentioned, the alternate target is noted. For 'concreteness", presence of concrete ideas to implement the decarbonization vision is checked. The Monitor also looks for evidence of intermediate targets, e.g. for 2030, 2040 and roll-out plans in the sector.

In addition, the length of renewable energy plans is analyzed for countries which do not have a binding long-term decarbonization strategy. Where plans are too short-term (in this case only up to 2020), countries are scored 0 because of their lack of ambition in vision-setting for renewables.

2. Renewable energy ambition

The renewable energy ambition rates a country's renewable energy generation targets against a path towards full decarbonization by mid-century (2050). It is assumed that countries undertake a linear progression towards a fully decarbonized power sector departing from the current mix to achieve both country and decarbonization targets. To correct for the fact that countries provide targets in different years, the yearly growth rate needed to reach the country target is compared to the yearly growth rate of renewable energy generation needed to reach full decarbonization by 2050. The growth rate is calculated using a percentage point increase between the current and target share of renewables divided by the number of years between the analysis and the target year. This approach is valid for both country and decarbonization targets.

Renewable energy sources include variable renewable technologies, e.g. solar and wind, and baseload technologies, like hydro and bioenergy. For countries where targets are only given for small hydro, current hydro share is assumed to remain constant.

Since country targets are not provided consistently for every country, the data collected was adjusted to reflect a generation share in the target year. In cases where target date is provided in terms of capacity, capacity targets are converted to generation using capacity factor information available in the most recent World Energy Outlook (2018). Country specific information should be prioritized but worldwide data was used when data was not available. Decarbonization targets are defined as 100% low carbon sources in 2050. For countries with installed nuclear capacity, it is assumed that the share of nuclear drops to half by the year of decarbonization and the remaining mix is taken up by renewables.

3. Coal and oil exit plans

The Monitor checks for countries which have announced and agreed plans to phase out fossil fuel-based power generation sources. For countries with a substantial share of coal in their power generation mix, checks were made for: formal announcements on phasing-out coal-based power as an executive order, parliamentary decision etc.; and evidence of a phase-out plan being under consideration, e.g. through informal announcements or member of international coalitions on coal/oil phase out. For countries where oil has a significant share in power generation (e.g. Saudi Arabia), additionally checks for plans to move away from oil were made. Countries where no evidence of coal and/or oil exit plans was found were scored 0 as an evidence of continued role of fossil fuel-based generation.

4. Reliability of support to renewables

Reliability of support to renewables evaluates both historic support fluctuations and expected changes to the renewable policy framework ('Party consensus'). The indicator is used to help assess whether investors can have certainty that countries follow through on their renewable energy policies and based on a survey distributed to in-country experts.

The fluctuations in support considers both a country's general historic level of support for a low-carbon transition and the coherency of the support. By accounting for both variables, investors can identify countries that seem responsive towards climate change action but lack a coherent long-term approach. On the other hand, countries that are very determined in their approach but lack the necessary level of support for a low-carbon transition can also be assessed accordingly. Furthermore, it is important for investors to anticipate future developments concerning the political framework. By assessing the political consensus between parties on the importance of climate change policy in general and support policies for renewables in particular, the likelihood of a policy change – which is itself dependent on the prospects of a change of government – can be estimated.

To assess fluctuations in support, countries are evaluated based on their past performance in terms of promoting a low-carbon transition. Two main factors are considered:

- **Sustained Support:** assesses the countries general level of support for a low-carbon transition in the energy sector in the past
- **Historical Reliability:** assesses the general coherence of support for a low-carbon transition in the energy sector in the past

Sustained Support: A country's level of Sustained Support for a low-carbon transition is assessed by determining its average performance in terms of introducing effective energy policy measures. Performance is estimated based on expert judgements taken from the CCPI 2012-2018.

Historical Reliability: A country's reliability regarding its support for a low-carbon transition is assessed by tracing a country's level of Sustained Support for a low-carbon transition in the energy sector over the past seven years (2012-18). Estimating the fluctuation in support allows identifying countries that are rather volatile in their support.

However, the possibility that major fluctuation could be attributed to major performance improvements is accounted for by relating the variation to the average level of support over that same time period. The same logic applies for countries that follow a coherent approach but lack a sufficient level of support for a low-carbon transition.

In addition, to assess a country's anticipated reliability of support for a low-carbon transition, countries are evaluated regarding their Party consensus concerning ambitious renewable energy policies:

- **Risk Predictability:** assesses the *level of political consensus* concerning renewable energy and risks that future governments will reverse a country's climate change policy while accounting for issues with non-democratic countries.

Risk Predictability: Following Schmidt (1996) partisan influence in democracies on public policy is, albeit limited, nonetheless significant as parties are expected to act upon their agenda once they form the government. Assessing party positions (i.e. the level of Party Consensus) therefore is a promising approach to anticipate major policy changes.

Scoring approach

For indicators 1-3, scoring was done by cross-checking information obtained on countries against the scoring benchmarks defined in Table 1.

For indicator 4, the general level of support for a low-carbon transition is based on countries' performance in terms of introducing effective climate change policies in the past. Performance is estimated by calculating the average country score in the category "Energy Policy" in the Climate Change Performance Index (CCPI) between 2012 and 2018. The results are transformed to a 0 - 100 scale (where a high score accounts for a high average score in the CCPI).

Both results are aggregated in the following manner:

$$\textit{Historic Reliability of Sustained Support} = \textit{Score : Historical Reliability} \times \frac{\textit{Score : Sustained Support}}{100} \quad (2)$$

The Historical Reliability of Sustained Support score amounts to 50 percent of the overall Reliability of support to renewables score.

Differences in party positions regarding renewable energy are based on the level of party consensus concerning renewable energy which is estimated based on expert judgements. The results are transformed to a 0 - 100 scale (where a high score accounts for a high consensus)

Results from both indictors are weighed equally and mount up to a final score between 0 and 100.

$$\textit{Reliability of Support to Renewables} = \left(\frac{\textit{Historic reliability (score)} + \textit{Party consensus (score)}}{2}\right) \quad (3)$$

Data sources

1. **Long-term greenhouse gas strategies** were collected from the UNFCCC repository for country submissions. In addition, we looked for renewable energy policies and plans on a variety of policy databases such as NewClimate Institute's Climate Policy Database, London School of Economics' Governance and legislation Database and International Energy Agency's Policies and Measures database. In addition, media reports (till June-July 2018) were checked for any announcements.
2. **Renewable energy targets in plans and policies:** The information on renewable energy targets in countries' plans and policies collected for last year's monitor was the starting point for data collection on this indicator. This information was updated using information from a range of tracking projects/ activities at NewClimate Institute and Germanwatch. These include the Climate Change Performance Index and the Climate Action Tracker. Information on renewable energy target years (used for indicator 1.1) and target values (used for indicator 1.2) was collected for up till June-July 2018.
3. **Power generation mix:** Data on power generation mixes of countries was taken from IEA's Energy Balances. Year of data was 2016.
4. **Coal and oil exit plans:** The first point of information on agreed coal and oil exit plans was the database of 'Europe beyond coal'. Media reports for such announcements and expert knowledge on the subject was used for non-European G20 member states.
5. **Global alliances on coal/oil phase-out:** Country members of the 'powering past coal alliance', launched in COP 23, were considered.
6. **Reliability of support to renewables:** Data for the fluctuation of the support and the average ambition of the support are taken from the CCPI 2012-2018. For the party consensus an email-based survey of country experts was conducted. A total of 76 responses with at least 2 responses per country were received.

Category 2: Policy environment for renewables

Category 2 assesses the adequacy of a country's policy support environment to promote renewable energy investments. It evaluates a country's performance against comprehensiveness of direct support policies and four factors which facilitate successful project development.

To decide whether to engage in energy markets, investors need information on the policy framework supporting renewables in the country, including direct policy support for renewables through instruments such as feed in tariffs, auctions, renewable portfolio standards etc. and the factors that ensure the investments are realized smoothly.

Analysis of a country's main policy support scheme in place is the core element of assessment in this category. The aim is to evaluate the policy support's comprehensiveness, here called 'favorability'. Additional financial incentives were also considered to guarantee financial viability for investors. Besides a successful policy framework, a number of other measures that would enhance the investment environment are considered. The successful deployment of renewables oftentimes depends on the details of the policy scheme in place, as well as on the avoidance of any disturbance factors, such as strenuous administrative processes. Thus, a detailed analysis was undertaken to ascertain the quality of implementation.

In order to arrive at the indicators, a range of literature on policy effectiveness was considered. These included recent panel data studies that investigate the correlations between policies and renewable energy deployment (Aguirre & Ibikunle, 2014; Baldwin, Carley, Brass, & MacLean, 2017; Carley, Baldwin, MacLean, & Brass, 2017; Polzin, Migendt, Täube, & von Flotow, 2015), review studies on the challenges towards large scale integration of variable renewable energy sources (VREs) (Hu, Harmsen, Crijns-Graus, & Worrell, 2018; Hu, Harmsen, Crijns-Graus, Worrell, & van den Broek, 2018; Lund, Lindgren, Mikkola, & Salpakari, 2015) as well as policy studies from the International Renewable Energy Agency (IRENA, 2016b, 2018c).

Assessment approach

We apply a benchmarking approach for scoring. The method defines a set of indicators for a desired outcome, in this case, a policy support framework which facilitates renewable energy investments and uptake, and scores them based on pre-defined scoring benchmarks. A 0-100 scoring scale is used. The scores for indicator 2.2 are aggregated using a weighting scheme based on expert judgement. Scores of Indicator 2.1 were multiplied with that of indicator 2.2 to get the final scores. The indicators and scoring benchmarks are summarized in Table 2.

TABLE 2 Composition of 'Policy environment for renewables' category

Indicator	Scoring benchmark	Weighting	
2.1 Direct support policies	**100:** *All 5 policy support conditions are in place* i.e. Favorable support policies exist for ALL 4 major renewables (i.e. small and large scale solar, onshore and offshore wind) and are complemented by conducive financial support policies and measures to mitigate financial risks (condition 5)		Multiplied with below
	75: Either favorable support policies exist for only 3 renewable energy technologies with complementary financial support policies or support policies exist for all 4 renewables but without complementary financial support policies and measures to mitigate financial risks i.e. *only 4 of the 5 policy support conditions are met*		
	50: Only an *initial policy support* exists (i.e. support policies cover less than 3 technologies and/or policy support is technology neutral) but *with* complementary conducive financial support policies		
	25: Only an *initial policy support* exists (i.e. support policies cover less than 3 technologies and/or policy support is technology neutral) but *without* complementary conducive financial support policies		
	0: No support for renewables / support announced but not yet implemented / Support schemes in place do not necessarily provide sufficient incentives to level the playing field for renewables against fossil fuel-fired technologies (e.g. only tax breaks and accelerated depreciation without other policies).		
2.2 Factors ensuring realization	**Mid-term certainty of policy signals**	**40%**	Multiplied with above
	100: Clear signals of policy support provide certainty to investors on the medium-term prospects of investing in renewables. E.g. for auctions, presence of clearly defined auctioning schedule and prior-information on future auctioning rounds. For feed in tariffs (FITs) the level for support for new project coming on line is defined for the coming 5 years, i.e. no uncertain cap.		
	50: Few instances of policy stoppers (in just some regions or for some technologies), or the country is in transition, which results in policy uncertainty		
	0: Incomplete/suboptimal implementation, favoritism, bad policy design, policy fluctuations, On- and off policies		
	Administrative procedures	**20%**	
	100: Streamlined procedures for permitting renewable energy projects speed up uptake		
	50: Standard administrative procedures		
	0: Bureaucratic and in transparent procedures are inhibitory and scored 0		
	Ensuring realization	**20%**	
	100: 100: Ensuring the projects are really implemented E.g. for auctions: (1) Pre-defined realization periods in policy schedules exist, (2) pre-qualification requirements can help identify "serious" bids and eliminate projects with low realization probability (3) effective penalties for non-realization. For FITs and RPS, always scores 100 as generally do not have a similar need for checking realization		
	75: For auctions: two of the three		
	50: For auctions: one of the three		
	0: None of the above		
	Ensuring use of produced electricity	**20%**	
	100: Priority dispatch and compensation in case of curtailment.		
	50: Priority dispatch, but no compensation for curtailment		
	0: No priority dispatch and no compensation for curtailment		

Indicators and scoring methods

1. Direct Support Policies

This indicator measures the favorability of policy support for renewables.
The assessment differentiates between: a) policies for direct support; and b) financial and fiscal incentives.

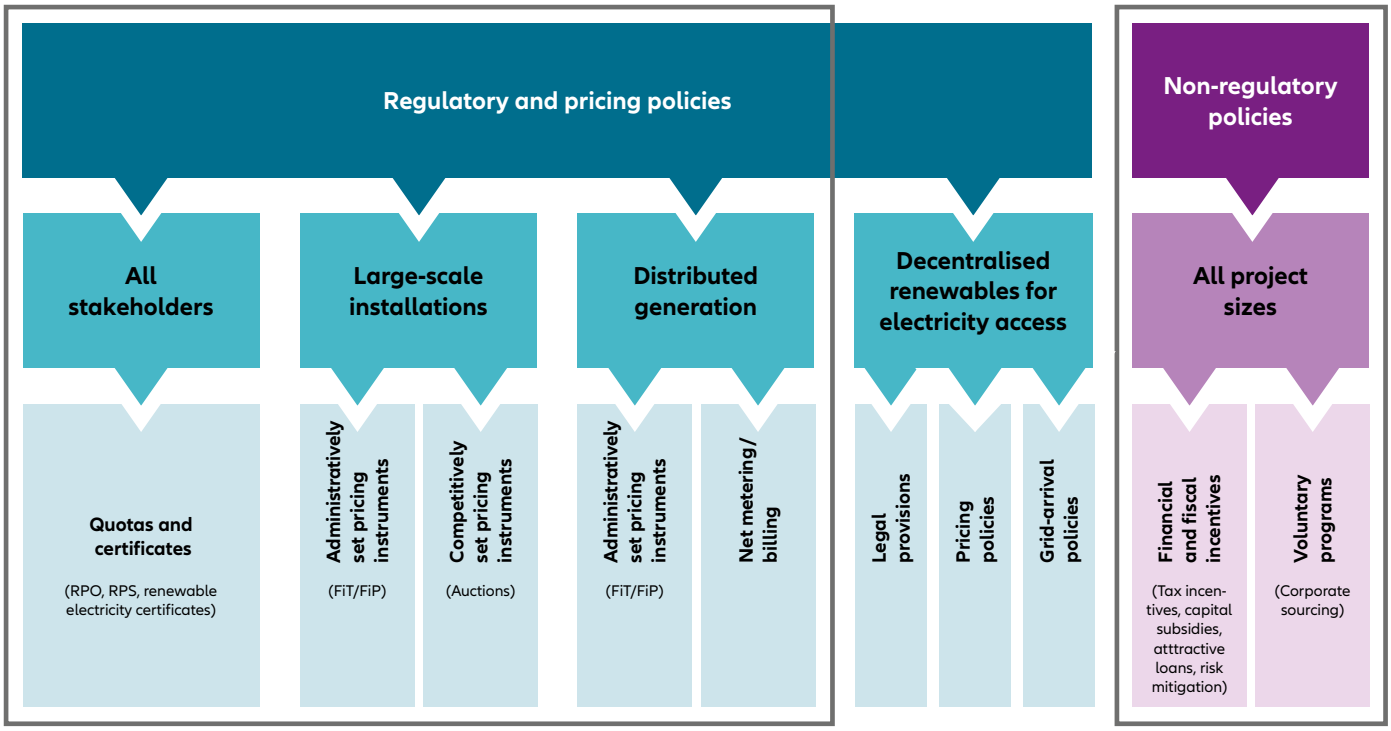
– **Policies for direct support:** Policy instruments considered in the analysis were derived from the categorization in IRENA's 'Renewable Energy Policies in a Time of Transition' report (2018c, p. 60) and Figure 3 below. Policies for decentralized energy access using renewables such as towards mini-grids and standalone systems were outside the scope of the assessment and were excluded.

  The instruments considered are: feed-in-schemes, covering both feed-in-tariffs (FiTs) and feed-in-premiums (FiPs); Renewable Energy Quotas and Mandates: formulated as Renewable Portfolio Standards, RPS or Renewable Purchase Obligations, RPO and associated certification systems such as Renewable Certificate Schemes (RECs); and Distributed generation support instruments such as Net Metering.

– **Financial and fiscal incentives:** For arriving at a workable list of conducive finance and fiscal incentives, we build on recommendations made by IRENA (2016b) on the role of risk mitigation and structured finance for unlocking renewable energy investment. In terms of instruments, the role of risk mitigation instruments, policies for mobilizing more capital market investment and engagement of local financial institutions in renewable energy finance for scaling up renewable energy investments is stated. Hence, we look for presence of the following financial instruments and/or incentives: priority sector lending, differentiated interest rates, dedicated funding mechanisms, green bonds issuance guidelines. However, financial incentives were considered only as a supplementary measure to direct support policies. If financial policies were found to be non-existent or marginal, the scoring was lowered.

The indicator uses a scoring benchmark-based approach for judging the favorability of support for investors. Favorability is judged by the presence of a comprehensive package of direct support policies to promote deployment of renewables and use of generated power. To assess the element of comprehensiveness, technology coverage was considered, as diversification assures energy security and stability of the grid. Because each renewable technology has a different level of maturity in the assessed countries, different levels of cost-competitiveness exist. Hence, a diversified policy approach was used, taking into account the special circumstances of each technology (AURES, 2016; Held, Ragwitz, Gephart, Visser, & Klessmann, 2014).

FIGURE 3 Coverage of power sector policies used in the assessment



Note: FiT = feed-in traiff, FiP = feed-in premium, RPO = renewable purchase obligations, RPS = renewable portfolio standards
Source: Adapted from IRENA, 2018d

Coverage of policies in the monitor's assessment

2. Ensuring Realization

This indicator combines factors which ensure the investments are realized smoothly. Four factors were considered based on literature: 1) mid-term certainty of policy signals, 2) presence of streamlined administrative procedures for permitting, 3) factors ensuring the renewable energy plants are set up on time; and 4) factors that ensure the generated power is used.

– **Mid-term certainty of policy signals:** This proxy evaluates the regularity and predictability of policy support in a country. Clear signals on continuation of a policy provide certainty to investors on the medium-term prospects of investing in renewables. E.g. for auctions, presence of clearly defined auctioning schedule (i.e. time between call for auction and bidding; and regular rounds of auctions) and prior-information on future auctioning rounds (i.e. auctioning timeline) were checked as these were pointed as key confidence building elements in literature (AURES Consortium, 2017; del Río, 2017). In addition, evidence of policy related uncertainty such as on-and off-policy support, sub-optimal enforcement of a support policy, regressive policy design and non-policy related fluctuations were checked for the assessment year. The presence of such 'policy stoppers' were given lower scores. As the stability and predictability of policies in place is pivotal in assuring successful investment, this proxy gets the highest weighting.

- **Administrative procedures:** This proxy measures the quality of administrative procedures, as their quality can be either facilitative or prohibitive for participation in policy instruments, such as auctions (AURES Consortium, 2017; del Río, 2017). Thus, information was gathered from literature if administrative procedures for building a renewable energy plant were streamlined or strenuous.

- **Ensuring realization** considers if the policy design has checks in place to ensure that the renewable energy projects are built. This is specifically an issue with auctioning. For countries where auctioning is the main policy instrument, presence of the following three design features was checked: 1) Predefined realization periods i.e. the deadline to build a power plant), 2) adequate prequalification requirements to eliminate non-serious bidders; and 3) penalties in place in case agreed timelines are not complied with, are considered good practice to reduce the risk that awarded bidders do not realize their projects (AURES Consortium, 2017; del Río, 2017; Kreiss, Ehrhart, & Haufe, 2017).

- **Ensuring use of produced electricity** directly influences the return of investment. Two factors are considered here: First, priority dispatch for renewables, which provides a guarantee to the generator that produced electricity will be prioritized by the transmission and/or distribution company when balancing the grid for supply and demand. Second, the compensation in the case of curtailment, which ensures revenue for the generator even in the case that there is curtailment.

We note that we only checked for the presence of such factors and not the level at which these are designed in country contexts. That information, though valuable, was not considered necessary for our purposes to check if policymakers design policies keeping in mind that investments are smoothly realized.

After determining the scores for both indicators, the final score for category 2 is calculated by multiplying the respective indicator scores.

*Policy environment for renewables = Direct support * Ensuring realization* (4)

Data sources

A variety of data sources were consulted for each of the indicators and proxies. Policy information was preferably gathered from ministry websites or international policy databases such as the IEA Policies & Measures database[2], the RES Legal database[3], Climatescope[4], and from country-specific studies or reports. If no information was available through those channels, media reports were reviewed.

As more detailed information was needed to complete the scoring for indicator 'Ensuring realization', more in-depth case studies were additionally included, such as the case studies from the AURES project for information on auctions and IEA country reports for detailed information on administrative processes. If no such reports were available, market research, for example Thomson Reuters Practical Law provided further information. For ascertaining policy stoppers for the proxy 'medium-term certainty of policy signals' more recent policy development was needed, thus relevant international and local media outlets were checked. Collected information was wetted with in-house country experts and where needed (e.g. for South Korea), country experts were consulted.

The data collection timeframe was up to July-August 2018.

2 https://www.iea.org/policiesandmeasures/ (accessed August 2, 2018)
3 http://www.res-legal.eu/ (accessed August 2, 2018)
4 http://global-climatescope.org/en/results/ (accessed August 2, 2018)

Category 3: Conditions for system integration

This category assesses if a country is prepared for system integration of variable renewable energy. It checks for the presence of policies on variable renewable energy in grid codes, storage promotion and the flexibility of demand and supply of variable renewable energy.

Assessment approach

This category has been newly introduced to reflect a growing requirement for governments to plan for higher shares of renewables in the grid. Resounding evidence now exists on the need for, and ways and means by which the power system should adapt to an increasing share of variable renewables such as solar and wind (IEA, 2017; IRENA, 2018d). It was identified that while consensus exists on the need for system integration, the exact mechanics of policy support for system integration are an area of discussion. Therefore, this category only considers the presence of policies on three needed elements for system integration, rather than their adequacy and quality. The following policies were considered:

- **Variable renewable energy (VRE) in grid codes:** Grid codes play a key facilitative role in the integration of renewables into the power system by detailing the technical requirements for renewable energy plants when connecting to the power grid (IRENA, 2016a). VRE integration in grid codes is an emerging topic of investigation as more and more countries strive for higher shares of renewables in their energy mix.

- **Policies for storage promotion and flexible supply:** Conventional energy storage such as pumped hydro or batteries can play an important role in supplying flexibility to the grid.

- **Demand side management (DSM) policies:** DSM policies can be categorized in different ways depending on the coverage of sectors and actors, e.g. energy providers only or other demand sectors such as buildings, appliances as well (Warren, 2015).

The assessment approach is summarized in Table 3 and explained in the following paragraphs.

TABLE 3 Composition of 'Conditions for system integration' category

Indicator	Proxies	Scoring benchmarks	Weighting
3.1 VRE in grid codes	– Does the country have a grid code that includes measures or standards addressing variable renewable energy? (Question from RISE index)	**100:** yes **0:** no	**33%**
3.2 Storage promotion and flexible supply side policies	– Policies for storage promotion and flexible supply side policies	**100:** yes **0:** no	**33%**
3.3 Demand side management promotion	– Market based policies – Regulatory policies	**100:** Both markets based, and regulatory DSM policies are present **50:** Only market or regulatory DSM policies are present **0:** no policy present	**33%**

Indicators and scoring

VRE in grid codes: Finding an indicator to compare countries for the suitability of their existing grid codes for variable renewables or specific variable renewable energy codes is extremely challenging as these technical specifications are highly specific to the power systems in question (e.g. the size of the power system, if it's an isolated or interconnected system, geographical distribution of renewable resources) and extent of existing and planned renewables. Hence, for this assessment we only check if the country has a grid code that includes certain measures or standards addressing variable renewables and is based on results from World Bank's Regulatory Indicators for Sustainable Energy (RISE) index.

Policies for storage promotion and flexible supply: National and sub-national efforts on promotion of storage and flexible supply were considered. Private sector efforts were not scored.

Demand-side management policies (DSM policies): For the purposes of this assessment, we built upon the policy characterization of market-based, regulatory, information, fiscal and voluntary DSM policies by (Warren, 2015). We limited our enquiry to mandatory policies which either provide incentives (called market-based policies in this assessment) or regulate demand side energy efficiency measures (called regulatory policies in this assessment). More so, we only considered policies that directly target energy supply infrastructure (i.e. up till the energy reaches a consumer). Hence, energy efficiency measures directed towards buildings (e.g. building standards) and appliances (e.g. labelling) were excluded from the assessment. Voluntary agreements and information and fiscal support policies were also excluded because of the rather broad ways in which these could be designed, making data collection a challenge.

- for *market-based DSM policies*, we looked only for dynamic power pricing policies which aim to shift and/or shape energy use of end-users (e.g. time-of-use pricing).
- for *regulatory DSM policies*, we looked at two types of policies: 1) utility obligations/energy efficiency obligations; and 2) smart meter roll-outs. Utility obligations refer to schemes setting energy saving obligations/quantitative targets for energy distributors and/or retail energy sales companies and possibly coupled with a trading system (e.g. tradable white certificates, trading of eligible measures without formal certification, or trading of obligations) (European Energy Efficiency Platform (E3p), 2018; Joshi, 2012). Utility obligations are usually backed by legislation and regulation and involve penalties for utilities that miss their targets (Warren, 2015). Smart meter roll-outs were counted only when they were undertaken under a policy mandate.

Scoring approach

The three indicators were assessed on a 0-100 scale and aggregated using an equal weighting scheme. The first two indicators (~VRE in grid codes and Storage promotion and flexible supply side policies) are either scored 0 or 100, based on policy presence. The third indicator 'Demand Side Management Promotion' has a 3-point scale as it considers both regulatory policies and market-based policies. The presence of either of the two types of DSM gives a score of 50, policies in both areas a score of 100. After determining the scoring, all indicators are given the same weight and aggregated according to the following formula:

$$\textit{Conditions for System Integration} = 0.3 * \textit{VRE in grid codes} + 0.3 * \textit{Storage promotion} + 0.3 * \textit{DSM promotion} \quad (5)$$

Data sources

No comprehensive databases exist on the indicators we were checking. Thus, relevant policy information was collected from a variety of sources. The information on grid codes was mainly gathered from World Bank's RISE index database, whereas information on system integration and demand side management was gathered from official government websites, the IEA renewable policy database, market research agencies and news outlets.

Category 4: Market absorption capacity

Market absorption capacity assesses a market's maturity and capacity to implement low-carbon energy infrastructure. Here, an assessment is made of the human and corporate capacities to drive the demand, supply and distribution of renewable energy technologies.

Assessment approach

As a first step in structuring this category, five possible factors that determine market absorption capacity were identified. These five factors are considered for the development of the category indicators, but are not all assessed directly:

- **Prior experience with technologies:** Countries with significant historical experience in the production, installation and usage of specific renewable technologies (solar and wind power in the current assessment) are likely to have developed favorable conditions for increased uptake. In these countries, suitable facilities for production and infrastructure for distribution are likely to be in place. Furthermore, advanced technical skills for development, construction, installation and maintenance of renewable technologies are likely to be readily available through a significant existing work force within the sector.

- **Prevalence of manufacturing and distribution companies:** The majority of the world's largest companies in the renewable energy industry are multinational companies that establish presences in countries with a potentially conducive market environment around the world. The presence of these companies in a country is an indication of the perceived market potential. Furthermore, a larger number of renewable energy companies operating within a country indicates a higher level of competition in the market, improved availability of technologies for project developers and end-users, increased likelihood of enhanced distribution networks in the country, and a greater availability of technical capacity with regards to skilled labor.

- **Technical human capacity:** Although not all countries need to be on the cutting edge of global technological advance, each country needs the capacity to understand, adopt, and if necessary adapt, global technologies for local needs (Desai et al., 2001). Technical human capacity is relevant for market absorption capacity on two levels. In the present, the current availability of skilled technicians is vital to the efficient production, installation and usage of renewable energy systems. Looking into the future, the quality of universities and the volume of students pursuing degrees or training programs related to engineering or energy systems, is an indication of the technical capacity that will be available to bolster market absorption capacity in the short- and longer-term future.

- **Technological readiness:** Technological readiness affects the ability to adopt and make use of the most modern solutions. At the rudimentary level this includes the penetration of modern communications infrastructure across businesses, whilst at the most technical level it includes the penetration of advanced machinery for precision manufacturing and high-tech infrastructure and processes for distribution. An economy with a greater technological readiness is likely to create a higher demand for modern solutions, as well as having the capacity to fulfil such demand.

– **Research, development and innovation:** Beyond the capacity to adopt new global techniques, countries also need capacity to invent and adapt new technologies for local needs (Desai et al., 2001). The importance of this factor for renewable energy is not great in all countries, since global technologies for wind and solar in particular are usually universal and require limited adaptation to local conditions. However, exploitation of potentials for locally variable technologies such as geothermal and biomass energy, usually requires strong leadership from the host country on the research and development of locally appropriate solutions.

From these five factors described above, 'technical human capacity', 'technological readiness' and 'capacity for research, development and innovation' were excluded. While these may be assessed on a general level, information specific to renewable energies on these factors is available. In place of these, an assessment is performed on the 'current level of activity in the sector', which considers all of these three factors to certain extent. **Thus, the 'prior experience with (renewable) technologies' and the 'prevalence of businesses for manufacturing and distribution (of renewables)' are evaluated for assessing the market absorption capacity for renewable energies.**

Table 4: Composition of 'market absorption capacity' category presents an overview of these evaluation criteria, including proxies for each. Consistent with the insight that investors place less significance on local manufacturing capacity than on the actual installation of systems that may have been manufactured elsewhere, less weighting is given to the indicator for the presence of businesses for manufacturing and distribution of renewable technologies. This remains a factor in our evaluation since the presence of these businesses covers not only manufacturing capacity but also the depth and competition within supply chains, as well as being a general indicator of the attractiveness for foreign investment.

The subsequent paragraphs explain the scoring scheme for proxies that define each indicator and the data collection approach.

TABLE 4 Composition of 'Market absorption capacity' category

Indicator	Proxy	Assessment approach	Weight
4.1 Prior experience with renewable energy technologies	– Total installed capacity of solar and wind energy (per capita) (MW) – Share of renewables (excluding all hydro) in electricity generation	Normalization and aggregation of absolute data	**40%**
4.2 Current level of activity in the installation of renewable energy	– New installed capacity of solar and wind energy over past year (per capita) (MW)	Normalization and aggregation of absolute data	**40%**
4.3 Presence of businesses for manufacturing and distribution of renewable technologies	– Locations of headquarters and regional and national offices for the 30 largest renewable energy companies in the world, according to the Renewable Energy Industrial Index (RENIXX).	**100:** Presence of almost all of the world's largest multi-national renewable energy companies in the country. **75, 50, 25:** Degree of business presence. **0:** No presence of the world's largest multinational renewable energy companies in the country	**20%**

Indicators and scoring methods

1. Prior experience with renewable energy technologies

This indicator demonstrates the historical deployment of renewable energy technologies in the country as a means of assessing the experience accumulated in the installation and regular operation of renewable energy systems, and their integration into national electricity infrastructure.

The following data is collected for the construction of the indicator:

- **Share of renewables (excluding hydro) in total electricity generation** (%)
- **Total installed capacity per capita**
  - → Total installed capacity of wind electricity (per capita) (MW)
  - → Total installed capacity of solar electricity (per capita) (MW)

Although both data sets present similar information, there are subtle differences between the two that favor the consideration and compilation of both sets of information into one aggregate score. The share of renewables demonstrates the countries' total stock of renewable energy relative to total electricity generation, and therefore indicates the importance of renewables for the national energy system and the extent to which renewables are successfully integrated into the provision of national energy demand. However, for countries with significantly lower energy demand per capita, or even suppressed demand due to delayed development trajectories, a higher share of renewables does not necessarily indicate a greater level of experience and capacity to work with the technologies when compared to a country with a similar or lower share of renewables but a much greater total energy supply per capita. As such, the total installed capacity per capita is considered alongside the share to reflect both of these factors.

For total installed capacity per capita, wind and solar technologies are assessed as a proxy for all non-hydro renewables, due to the high relevance of these technologies, and the stronger availability and reliability of data, compared with other renewable technologies such as geothermal and biomass.

Scoring approach

The two data sets for installed capacity – *total installed capacity of solar electricity per capita* and *total installed capacity of wind electricity per capita* – are aggregated with equal weighting in order to produce a combined score for total installed capacity of wind and solar energy. This combined score for installed capacity is then aggregated along with the *share of renewables in total electricity generation*, to produce the final indicator.

For aggregation of the proxies, the spread of country data for each is normalized to a value between 0 and 100, and an average of the two data sets is taken as the final value.

2. Current level of activity in the installation of renewable energy

Information on the current level of activity provides a strong indication of multiple conditions for market absorption capacity: high levels of activity confirm the availability of technical expertise, technological readiness and the ability to adopt and adapt technologies for local use, whilst also demonstrating proficiency in supply and distribution chains for renewables. Although this indicator is influenced by factors that fall outside of market absorption capacity, such as policy incentives, this impact is reduced by its use as one of three indicators that are aggregated for assessment of market absorption capacity.

The following data is collected for the construction of the indicator:

- **Annual new capacity installed in the past year (2017) (per capita)**
  - → Annual new solar electricity capacity installed in most recent year available (per capita) (MW)
  - → Annual new wind electricity capacity installed in most recent year available (per capita) (MW)

Wind and solar technologies are assessed as a proxy for all non-hydro renewables, due to the high relevance of these technologies, and the stronger availability and reliability of data, compared with other renewable technologies such as geothermal and biomass.

Scoring approach

The secondary data sets are normalized and aggregated with equal weighting to produce the scores for *new capacity installed in the previous year* and *forecast new capacity installed*, and these scores are then aggregated to produce the final indicator score.

3. Presence of businesses for manufacturing and distribution of renewable technologies

This indicator looks at the global distribution of the world's largest companies for renewable energy, and assesses their presence in the G20. The presence of a larger number of companies indicates deeper, more reliable, and more competitive domestic markets for renewable energy technologies.

Data for largest renewable energy companies globally is gathered from the locations of headquarters and regional and national offices for the 30 largest renewable energy companies in the world in the Renewable Energy Industrial Index (RENIXX).

Scoring approach

For each country, it is determined what percentage of the 30 largest renewable energy companies in the world have a physical presence, in terms of a physical office address, within the country. The data is normalized as per the standard approach elaborated in this technical note.

Data sources

1. **Prior experience with renewable energy technologies:** Data on installed capacities for the most active countries is collected from the country individual IRENA Statistics, Capacity & Generation (IRENA, 2018a). For the per capita calculation this report retrieved population data for 2017 from the World Bank (The World Bank, 2018). The share of renewables (excluding hydro) in total electricity generation is calculated based on the World Energy Statistics and Balances database of the IEA (IEA, 2018).

2. **Current level of activity in the installation of renewable energy:** Data for new capacity installations is obtained from the same sources as for the previous indicator i.e. the IRENA Statistics and the World Bank.

3. **Presence of businesses for manufacturing and distribution of renewable technologies:** Data was collected from the RENIXX index. RENIXX is a global stock index, comprising the world's 30 largest companies of the renewable energy industry, whose weighting in the index is based on free float market capitalization of the renewable energy companies from the sector wind energy, solar energy industry, hydropower, geothermal energy, bioenergy and fuel cell technology (Renewable Energy Industry, 2016). It can be seen as a representation of the global market and therefore can give an indication of trends and developments within certain sectors of renewable energy (IWR, 2017). The RENIXX is updated biannually and the weighting is adjusted every quarter. The date of extraction for the analysis in this report was 1 August 2018. Compared to last year's report analysis ten companies have changed within the compilation of the index. Data is collected through manual desk research, by visiting the websites of each of the top-30 listed companies and extracting information about their regional and national office locations. The table below describes the change in companies in the RENIXX index between last year and this year. Companies in shaded rows changed between the two years.

TABLE 5 Change in RENIXX companies in 2018

RENIXX 30 companies (Monitor 2018)	RENIXX 30 companies (Monitor 2017)
Brookfield Renewable Partners	Brookfield Renewable Partners L.P.
Canadian Solar Inc.	Canadian Solar Inc.
China Longyuan Power Group Limited	China Longyuan Power Group Limited
China High Speed Transmission Equipment Group Co., Ltd.	China High Speed Transmission Equipment Group Co., Ltd.
EDP Renewables	EDP Renewables
First Solar	First Solar, Inc.
GCL-Poly Energy Holdings Limited	Gamesa Renewable Energy
Green Plains Inc.	GCL-Poly Energy Holdings Limited
Innergex Renewable Energy Inc.	Green Plains Inc.
Jinko Solar	Innergex Renewable Energy
Meyer Burger	JinkoSolar Holding Co., Ltd.
Nordex	Meyer Burger Technology AG
Omat Technologies	Nordex SE
Plug Power Inc.	Ormat Technologies Inc.
Scatec Solar	Plug Power Inc.
Siemens Gamesa	Scatec Solar ASA
SMA Solar Technologies Inc.	SMA Solar Technology AG
Sunrun Inc	Sunrun Inc.
Tesla Motors, Inc	Tesla Motors, Inc.
Vestas Wind Systems A/S	Vestas Wind Systems A/S
Albioma	China Singyes Solar Technologies Holdings Limited
Ballard Power Systems	Enel Green Power S.p.A.
Encavis AG	Goldwind Science & Technology Co., Ltd.
Enphase Energy Inc	JA Solar Holdings
Huaeng Renewables Corp.	RECSilicon ASA
Orsted (former DONG Energy)	SolarCity, Corp.
Solaredge Technologies Inc	SunEdison, Inc.
Verbund AG	SunPower Corp.
Xinjiang Goldwind SC.&T.CO.LTD	Suzlon Energy Ltd.
Xinyi Solar Holdings	Trina Solar Limited

Category 5: General investment conditions

The general investment conditions category scores countries on a range of factors determining overall investment conditions. These influence an investor's perception of risks and returns when investing in a country.

Assessment approach

Investor preferences are guided by several factors which have been estimated in a variety of ways. A basic model is to represent investments as a function of risk, return and policy (Wüstenhagen & Menichetti, 2012). This category focusses on factors that define investor perception of risks and returns from investing in a geography. These factors can be broadly categorized into three: financial determinants, non-financial determinants and fundamental determinants of macroeconomic stability. Sector specific policy determinants are covered in detail under the *Policy environment for renewables* category.

1. **Non-financial determinants:** This set of indicators reflects the safety of investments in a country. A high score reflects the ease of investing in a country.

2. **Financial determinants:** Financial determinants facilitate investor confidence towards return on investment in a country.

3. **Macroeconomic fundamentals:** These variables provide some resilience to a country from external shocks; especially so in emerging markets.

A range of potential proxies were identified for each of these. As a next step, a prioritization exercise was carried out, based on literature review, particularly usage in related indexes and policy papers, and based on Allianz's feedback on a long-list. This was both desirable and necessary to ensure methodological simplicity of this overarching category. An indicator-dense category also risked eliminating any useful differences among indicators due to aggregation. The short-listed proxies are outlined in Table 6 and discussed in the following paragraphs.

TABLE 6 Composition of 'General investment conditions' category

Indicator	Proxy	Assessment approach	Weighting	
5.1 Non-financial determinants	– Openness to FDI in the electricity sector	Scores from the OECD FDI restrictiveness index	**6.7%**	**33.3%**
	– Regulatory ease of doing business	Scores of World Bank's ease of doing business index	**6.7%**	
	– Regulatory quality	Scores from Worldwide Governance indicators (WGI)	**6.7%**	
	– Political stability	Scores from WGI	**6.7%**	
	– Rule of law	Scores from WGI	**6.7%**	
5.2 Financial determinants	– Depth of capital markets	Sum of: Total Stock market capitalization (as % of GDP) + Outstanding domestic private debt securities (as % of GDP) + Outstanding international debt securities (as % of GDP)	**16.7%**	**33.3%**
	– Depth of financial institutions	Private credit (by deposit money banks) to GDP	**16.7%**	
5.3 Macroeconomic fundamentals	– Inflation forecast	IMF forecast for average annual % change in Consumer Price Index (five-year average)	**33.3%**	**33.3%**

Note: Indicator weights are rounded-off at one decimal digit

Indicators and scoring methods

Non-financial determinants: Long-term investors tend to attach substantial importance to factors that determine the security of investments in a geography. These are measured by the following:

1. Openness to FDI in the electricity sector

The nature and extent of statutory restrictions posed on Foreign Direct Investment (FDI) by countries is crucial for a foreign investor's ease of investing in a geography. We used the country scores for electricity generation sector in OECD's FDI restrictiveness index (2017) for our assessment[5]. The parent index assesses the FDI restrictions related to allowed equity contributions, restrictions in screening and approval procedures, restrictions related to employing foreign personnel and other operational restrictions not covered under the previous heads. The OECD index was chosen over others with similar coverage due to greater data granularity and recent data availability.

The parent index scores countries on a 0-1 scale; where 0 represents an open economy (no FDI restrictions) and 1 represents a closed economy (maximum FDI restrictions). These scores were inverted and rescaled to a 0 (closed economy) -100 (open economy) scale to make them consistent with our approach.

5 http://stats.oecd.org/Index.aspx?-datasetcode=-FDIINDEX#, (accessed August 1, 2018)

2. Regulatory ease of doing business

The regulatory ease of doing business measures the influence of domestic regulatory practices and procedures on the lifecycle of undertaking business in a country[6]. These are comprehensively measured in the World Bank's Ease of Doing Business Index. The parent index covers 10 topic areas with several indicators within each which discuss the *de jure* processes for doing business. For present assessment, we used the country statistics generated from the latest Ease of Doing Business (benchmarked to June 2017).

3. Regulatory quality

Supplementing the assessment of *de jure* regulatory practices, the regulatory quality indicator captures the 'perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private-sector development' (World Bank, 2015b). We used data from the 'Regulatory quality' indicator from World Bank's World Governance Indicators (WGI) (2016 update)[7].

4. Political stability

Political stability in a country can be major influencer in ascertaining the security of infrastructure investments made by an investor. We used the 'Political Stability and Absence of Violence/Terrorism' indicator from WGI for this indicator. The parent index provides a perception-based probability of 'political instability and/or politically motivated violence, including terrorism in a country'[8].

5. Rule of law

Rule of law reflects the safety of property rights of an investor in a foreign geography. We have used the 'Rule of Law' indicator from WGI for this. It captures the confidence of actors in societal rules particularly on the police and judicial system and the quality of contract enforcement and property rights[9].

Financial determinants: Financial depth of institutions and markets in an economy influence the return on infrastructure investments made in an economy. Financial depth can be sub-divided into depth of capital markets and depth of financial institutions in a country.

6. Depth of capital markets

Capital market depth is a proxy of the overall extent of services provided by a country's stock and bond markets (World Bank, 2015a). It reflects the ease with which assets can be bought and sold without substantial effect on their value (market liquidity). It is thus symptomatic of the ease of transaction in a geography for an investor. It is the sum of (1) stock market capitalization as a share of GDP, (2) outstanding volume of domestic private debt securities as a share of GDP and (3) international debt securities as a share of GDP. These are commonly used indicators for assessing depth of stock and bond markets (Cihak, Demirgüç-Kunt, Feyen, & Levine, 2012). The former assesses the value of total listed shares in the stock exchanges of a country relative to the percentage of national economic output. It indicates if the value of stocks in a market are over- or undervalued relative to the size of the economy i.e. if an investor underpays or overpays for stocks in that geography. The latter is a commonly used proxy for the size of bond markets in a country.

6 http://www.doingbusiness.org/rankings (accessed August 1, 2018)
7 http://info.worldbank.org/governance/wgi/index.aspx#home (accessed August 1, 2018)
8 Ibid.
9 Ibid.

The primary data source was World Bank's Global Financial Development database (June 2016 update)[10]. Some countries in the sample had missing values and/or lacked latest data. Previous year's values were used to fill the missing data points. Countries where no information could be found after review of other literature were assumed to be zero in the calculations.

10 http://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database (accessed August 2, 2018)

7. Depth of financial institutions

Depth of Financial Institutions is measured by *private sector credit to GDP ratio*. Private credit to GDP ratio measures the credit given to private entities by deposit money banks relative to the size of GDP. It reflects the activity of financial intermediaries in channeling savings to investments and investors (Garcia & Liu, 1999; Gurley, John G.; Shaw, 1955). Thus, deeper financial institutions facilitate investments. Further, financial institutions continue to play a key role in infrastructure financing in emerging markets, where capital markets are less deep and have a low engagement in infrastructure investment.

Another commonly used proxy that was initially considered was the ratio of *total banking assets to GDP*. It has a comprehensive coverage i.e. it includes credit to governments in addition to private entities as well bank assets other than credit. However, we chose *private credit to GDP* over it because of better data availability. In addition, being closely correlated to total banking assets to GDP, literature suggested that it presented a close approximation for total banking assets (Cihak et al., 2012 pp.11).

It is noted here that a generic indicator reflecting the depth of the banking sector is only a loose approximation for an indicator looking specifically at the depth of 'green lending' in countries. However, usage of generic indicators, though less desirable, is a common practice and the lack of sub-sector granularity in banking indicators in global policy indices well-acknowledged in recent stocktaking exercises (OECD, 2015).

Macroeconomic fundamentals: The influence of macroeconomic variables differs based on the type of market (developed vs. emerging), type of foreign flows (FDI vs. Foreign Portfolio Investments, FPI) and asset types but they provide an overall resilience to the vulnerable markets.

8. Inflation forecast

Among the assortment of macroeconomic variables such as inflation, GDP growth rate, exchange rate volatility, currency depreciation, interest rates etc.; inflation forecast was selected based on the client's experience as an institutional investor and from some literature evidence supporting its cruciality – in particular in emerging markets (IMF, 2014). Rate of inflation can increase the uncertainty of the return on investments over time and can be a risk if returns are not inflation-linked.

Our assessment uses the IMF forecast for the five-year average annual percentage change in Consumer Price Index (CPI) provided in the World Economic Outlook from April 2018[11]. While the ideal rate of inflation differs from country to country, we generally assume that a stable, lower inflation is preferred by long-term investors in our scoring.

11 https://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx (accessed August 3, 2018)

As illustrated in Table 6, the three umbrella indicators and their underlying proxies were aggregated using equal weights.

Data Sources

Raw data was collected from the following databases:

- **Indicator 1: Openness to FDI:** OECD FDI restrictiveness index[12]
- **Indicator 2: Regulatory practices:** World Bank Doing Business Index[13]
- **Indicators 3,4,5: Political stability, Regulatory quality and Rule of law:** World Bank Worldwide Governance Indicators[14]
- **Indicators 6,7: Depth of capital markets and financial institutions:** World Bank's Global Financial Development database. World Bank's 'The little data book on financial development' was used for missing values[15].
- **Indicator 8: Inflation Forecast:** IMF World Economic Outlook[16]

12 Ibid.
13 Ibid.
14 Ibid.
15 Ibid.
16 Ibid.

Investment needs

The assessment on investment needs was revisited this year and no longer includes a ranking of investment needs. Instead, supplementary information for each of the G20 countries is provided.

To be compatible with the below 2°C goal mentioned in the Paris Agreement, the global energy system needs to undergo substantial structural transformations. This entails an increasing share of renewable energy in national energy provision as well as progress regarding energy efficiency and a higher flexibility of power grids (IRENA, 2018b). These transformations require a wide set of private and public investments. Investments as such are no net expenses as they generate future income and add value to the economy. Therefore, high investment needs are not necessarily a sign of unattractiveness.

The Allianz Climate and Energy Monitor 2018 illustrates the annual average investment needs in the power sector in G20 countries between 2016 and 2050 by employing a comparative approach, considering both a business-as-usual scenario and a well below 2°C compatible pathway.

Assessment approach

In order to move away from a country ranking of investment needs, a country-specific interpretation of the level of investment needs is required to make comprehensive and normative evaluation (i.e. there is no general rule whether high or low investment needs are more convenient for a country). Investments, other than expenses, add value to the economy as they imply generating future income. Instead of a ranking, the Monitor assesses countries by comparing their business as usual scenarios (*'Reference case'*) to a well below 2°C pathway (*'REmap case'*) for power generation and grids and energy flexibility, using data from IRENA (IRENA, 2017). As the data was provided for cumulative investments between 2016-50, we decided to divide total investment needs by the total number of years to obtain annual average investment needs. By comparing both scenarios, we illustrate the investment gap between a business as usual scenario and investments under a Paris compatible pathway.

Based on IRENA's REmap analysis (IRENA, 2017, 2018b), the reference case can broadly be defined as the business-as-usual scenario. It takes into account current and anticipated policies and integrates projected market dynamics. The data was collected by IRENA and includes national energy plans and targets, as well as forecasts. In case of data gaps, missing data has been replaced by reliable third-party analysis, official country resources or IRENA analysts.

The REmap case describes a low-carbon pathway (85% renewable power) that is aligned with a 66% probability of limiting the global average surface temperature increase to below 2°C by 2050. It includes renewable energy technologies (i.e. solar PV, CSP, onshore and offshore wind, bioenergy power plants, geothermal power plants, hydropower, ocean power), renewable energy feedstocks (i.e. for chemicals and polymers), energy efficiency measures (incl. electrification), material efficiency technologies (e.g. recycling, transport sector), and CSS for the industry.[17]

In addition, where possible, we also show current (2017) clean energy investments, based on Bloomberg New Energy Finance (BNEF) data.

17 For more in-depth information, please see (IRENA, 2017, pp.25).

Data Sources

1. Absolute investment needs indicator: IRENA
2. Current renewable energy investments: BNEF

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