CDC
Investment works

Guidance

Natural Gas Power Plants:
Assessing alignment with the Paris Agreement

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Introduction

1.1 Development of this guidance note

CDC has worked with Mott MacDonald and other stakeholders to develop this guidance note to determine whether natural gas to power opportunities are aligned with the Paris Agreement in the context of the geographies in which we invest.

1.2 Overview

Climate change is the most important issue facing our generation. In 2016, the Paris Agreement came into force, committing 197 countries to tackling climate change. A key objective of the Paris Agreement is to hold the increase in global temperatures to well below 2˚C above pre-industrial levels, and to pursue efforts to limit this to 1.5˚C. This goal requires global CO_2 emissions to be cut by 45 per cent by 2030 and reach 'net-zero' by 2050.[1] It demands a transformation of the global energy system and (as recognised by Article 2.1c of the Paris Agreement) for financial flows to be directed towards low greenhouse gas (GHG) emissions and resilient pathways.

Infrastructure investment decisions should, therefore, take into account whether they are consistent with the 1.5˚C temperature goal. Recent work by the World Resources Institute (WRI) provides a framework for doing this. It identifies three broad categories for infrastructure in relation to the Paris Agreement: *misaligned* (such as coal power plants), *aligned* (solar and wind) and *conditionally aligned*, (such as natural gas power plants) which can be consistent in certain circumstances.[2]

This guidance note provides a methodology for considering natural gas power plant investments in the context of the Paris Agreement. Specifically, it provides a framework to assess:

– Whether a potential investment in a natural gas power plant can be considered consistent with 1.5˚C emissions pathways, and is therefore aligned with the temperature goals of the Paris Agreement.

– Whether there is a substantial level of 'transition risk' associated with the investment opportunity (and if anticipated future revenue streams are vulnerable to changes in policy, technology or market conditions associated with a net zero development pathway).

The guidance note can be applied to new greenfield and brownfield investment opportunities, and is relevant to both equity and debt investments.

1 IPCC (2018) Special Report on Global Warming on 1.5˚C. According to the IPCC 'net zero emissions' are achieved when anthropogenic emissions to the atmosphere are balanced by anthropogenic removals over a specified period.

2 WRI (2018) Towards Paris Alignment. How the Multilateral Development Banks Can Better Support the Paris Agreement. Available at: https://www.wri.org/publication/toward-paris-alignment [Accessed 24-02-2020].

1.3 Our climate change strategy and approach to Paris alignment

We recognise that we must operate within the remaining global carbon budget to limit the global rise in temperature to 1.5°C. The change required to address the climate emergency is not incremental. Without a fundamental shift in how economies and sectors work, the 1.5°C target will be breached as early as 2030. Therefore, through our activities we will support economic transformation in each country to meet the challenge to be climate resilient and consistent with net zero emissions by 2050. As the UK's development finance institution, we have a specific responsibility to ensure the economic transformation is a socially just one for workers and communities, and delivers on the need for economic growth and improved living standards. We also recognise the need to 'future-proof' our operations, given the threat that climate change poses for our dual mandate of development impact and financial return.

These objectives underpin our Climate Change Strategy[3], which sets out three building blocks that align our activities with the Paris Climate Change Agreement.

- **Net zero by 2050** – we recognise the need for global anthropogenic CO_2 emissions to be reduced over the coming decades and reach 'net zero' by 2050, in line with the Paris Agreement's 1.5°C temperature goal.[4] Support for net zero development pathways is what our markets demand. We will take a combined approach to achieve net zero. First, we will look at overall emissions of our entire portfolio, including through direct investments and intermediaries, so that we can make future decisions based on the target to achieve net zero emissions at the portfolio level by 2050. Second, we will consider how each investment aligns to the individual country's pathway to net zero emissions by 2050. This guidance note provides the means by which natural gas power plant investment opportunities will be assessed against our net zero objectives.
- **Just transition** – the fundamental transition towards a new green and resilient economy provides an opportunity to build a fairer and more inclusive economy. The 'just transition' agenda promotes change that seizes the opportunity to be socially inclusive of workers' rights, women and communities, while managing the impact on those workers who will be negatively affected by the move away from particular sectors. Our focus on a just transition will be to help as many companies and communities to reap the benefits of the new green economy by focusing on job creation, along with reskilling and upskilling for roles in green and resilient sectors in the new economy. We will integrate the just transition agenda into our existing programme of work to address skills and leadership, gender and job quality. Just transition issues are not addressed within this guidance note, but are considered separately as part of our wider investment appraisal process.
- **Adaptation and resilience** – CDC's approach to this challenge will work on two levels. We will work with our portfolio companies to help identify risks and opportunities, and then implement strategies for those businesses to adapt and be resilient to the changing climate. Alongside this, we will increase our investment into solutions that deliver adaptation and resilience of sectors, businesses communities and people.

As part of our existing review processes, investments in areas identified as being at high risk of acute or chronic climate change impacts are subject to a screening level climate risk assessment and further detailed assessments as necessary.

Climate change adaptation and resilience issues are not covered in this guidance note.

1.4 Our mission and wider investment considerations

Our mission is to support the building of businesses throughout Africa and South Asia and to create jobs and make a lasting difference to people's lives in the world's poorest places. Sustainable development and poverty eradication therefore sit alongside climate change at the heart of everything we do.

In the context of the power sector, we believe it is critical to support investments that improve the quantity, reliability and affordability of energy to all users – to achieve economic development and improve energy access. These issues are considered for each investment we undertake:

1. We screen all power projects for their contribution to economic growth and job creation (Sustainable Development Goal (SDG) 8.5), improvements to quality of life (SDG 7.1 & 7.2) and tackling climate change (SDG 13).
2. The first – and most important – question is always whether a country needs the power, i.e. will there be sufficient demand. We always consider the impact on the power sector as a whole, not just for our project. Here, quality (including providing reliable power or diversifying the generation mix) matters as much as the quantity. We prioritise those "hardest countries" where the power sector is less developed and additional generation will make a greater difference.
3. In our markets, the poorest people are often paying the world's highest prices for energy. Tariffs matter, not just for the competitiveness of a power plant, but because they impact the cost base of businesses, the affordability for consumers and the sustainability of utilities.
4. Investments in the energy system of a country also must support its transition towards a net zero economy by 2050, while also ensuring climate resilience.

3 https://www.cdcgroup.com/en/climate-change-strategy/.
4 Net zero emissions will be achieved when anthropogenic GHG emissions to the atmosphere are balanced by anthropogenic removals over the same period.

We also undertake a screening review of environment and social (E&S) risks associated with any potential investment. This is followed by E&S due diligence that ensures all investments are in line with our Code of Responsible Investing.

1.5 The use and characteristics of natural gas for electricity generation

According to the International Energy Agency (IEA), the use of natural gas for electricity generation has more than doubled globally over the last two decades, from just under 3,000TWh annually in 2000 to over 6,000TWh annually in 2018 (around a quarter of total global electricity supply). In Africa, growth has been driven by Algeria and Egypt, with gas now overtaking coal as the continent's largest single source of power – due primarily to these two markets (although outside these markets, hydro remains a dominant resource in many markets). In parts of South Asia, such as Bangladesh and Pakistan, natural gas use in the electricity sector has also grown in recent years, although elsewhere in the region (e.g. India) use has stabilised or declined.[5]

Looking to the future, the IEA's Sustainable Development Scenario (SDS) sees the use of gas for electricity generation continuing to increase globally until the late 2020s (albeit at substantially lower levels of growth than recent historical trajectories), after which it begins to decline.[6] The IEA's 'Africa case' scenario, which is based around accelerated economic growth alongside the achievement of full energy access (but which is not necessarily aligned to Paris Agreement temperature goals), sees the use of gas for electricity more than double between 2018 and 2040, partly linked to the utilisation of indigenous resources in sub Saharan Africa.[7]

Natural gas power plants have a number of characteristics that have driven increased use and mean gas has a role to play in supporting net zero transitions over the coming decades:

- **Reliability and flexibility** – natural gas power plants can operate flexibly to provide a range of service to electricity grids, including reliable baseload, mid-merit and peaking power supply, as well as balancing and ancillary services such as inertia and frequency and voltage control. Over time, we expect an increasing number of alternative non-fossil solutions to these challenges also, depending on the situation and the extent of reliability and flexibility needed. For example, in more mature power markets, gas power is increasingly required for mid-merit or peaking power, with renewables providing an ever-rising portion (and, in some countries, the majority) of the electricity generation. Rapidly-declining costs of storage will likely further increase this trend. However, today gas generation remains a material part of a number of developed markets' *existing* grid generation, and for less-advanced grids in developing countries (which will need investment and time to absorb higher renewables penetration). Also, gas can play a role as a transition fuel where there is rapid demand growth but a very small existing gas fleet in absolute terms (compared to developed markets).
- **Emissions** – natural gas power plants can offer lower CO_2 emissions than other fossil fuels such as coal or heavy fuel oil (HFO) provided that upstream emissions from the production and transportation of natural gas are minimised and tightly controlled. However, even efficient natural gas plants still have much higher CO_2 emissions than renewables or nuclear power.
- **Affordability** – the cost of natural gas power plants can be lower than available alternatives – especially in providing firmer power for longer – although this depends on the context, competitor technology and fuel costs, and current market structures. Rapid changes in technologies and the potential for new market measures (e.g. carbon pricing) also mean that comparative costs are likely to change over time.
- **Land requirements** – gas is an energy dense fuel, which means natural gas power plants require significantly smaller land areas compared to other technologies such as wind and solar Photovoltaic (PV). This also means gas power plants can be located closer to demand with the potential for less land requirements for transmission infrastructure than more distant sources of generation.
- **Further economic considerations** – where gas can be sourced from indigenous supplies this can have advantages over imported fuels, for example in relation to costs, government revenues from production sharing and foreign exchange reserves. There are also benefits of gas in industry and downstream unlocking cleaner alternatives than existing fuels (such as kerosene in cooking, coal in industry).

1.6 Guidance note structure

This note is structured as follows:

- Chapter 1 – Introduction
- Chapter 2 – An overview of gas power plants in the context of the Paris Agreement
- Chapter 3 – How to use this guidance note
- Chapter 4 – Compatibility with Paris-aligned decarbonisation pathways
- Chapter 5 – Transition risk
- Glossary

5 IEA: Data and statistics.
6 IEA: Natural Gas-Fired Power.
7 IEA: Africa Energy Outlook 2019.

02

An overview of gas power plants in the context of the Paris Agreement

2.1 Overview

Since the Paris Agreement came into force, extensive work has been undertaken by the Intergovernmental Panel on Climate Change (IPCC) and others to set out the types of global GHG emissions pathways required to achieve the Paris temperature goals. This evidence provides a critical basis for considering whether, and in what circumstances, infrastructure such as natural gas power plants can be considered consistent with global temperature goals.

As part of this global picture, the Paris Agreement recognises that many least developed countries (LDCs) are still to go through their peak in GHG emissions.[8] This is due to an ongoing lack of reliable and affordable power supply, which is a key constraint to economic growth and standard of living in our markets. For example, 50 per cent of the population in sub-Saharan Africa currently has no access to power from the grid, while for those who are connected to the grid, quality and reliability of power remains problematic in many places. Addressing climate change alongside achieving sustainable development objectives is core to our approach to power sector investments.

2.2 IPCC Special Report on 1.5˚C

The IPCC's Special Report on 1.5˚C of global warming (2018) is based on a synthesis of the latest climate science.[9] The report finds that limiting warming to 1.5˚C is possible but requires global anthropogenic CO_2 emissions to decline by about 45 per cent from 2010 levels by 2030, reaching 'net zero' CO_2 emissions globally by around 2050. This in turn requires:

"Rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems. These transitions are unprecedented in terms of scale, but not necessarily in speed, and imply deep emissions reductions in all sectors."

The IPCC identified a remaining global carbon budget of ~420 $GtCO_2$ for a two-thirds chance of limiting warming to 1.5˚C, and ~580 $GtCO_2$ for an even 50/50 chance. It also estimates that committed emissions (specifically associated with existing infrastructure) amounts to more than two-thirds of this budget, implying very limited space for new fossil fuel infrastructure in Paris-aligned pathways.[10]

In relation to the power sector, the IPCC states that a "robust feature of 1.5˚C consistent pathways" is "virtually full decarbonisation of the power sector around mid-century". This is also a feature of 2˚C consistent pathways – indicating that GHG emissions must be virtually eliminated from the global electricity system by 2050, regardless of the precise level of sub 2˚C warming targeted. This does not necessarily imply that gas is no longer used for power generation by 2050, but that it is deployed with carbon capture and storage (CCS).[11]

8 Paris Agreement, Article 4.
9 IPCC: Special Report: Global warming of 1.5˚C (2018).
10 There is uncertainty in these figures and the IPCC report provides a more detailed and nuanced view of carbon budgets, temperature ranges and levels of certainty.
11 It should be noted that CCS technology is not yet commercially deployed at scale. Technical and economic challenges remain and where CCS technology is incorporated into fossil fuel power plants, it will need to be accompanied by substantial investments in CO_2 transportation and storage infrastructure.

Further investigation into several 1.5˚C compliant scenarios utilised for the IPCC report show that in Asia, gas-powered electricity production without CCS peaks between 2025 and 2030, before significantly decreasing out to 2045. In Africa, under these scenarios gas-powered electricity without CCS increases up to 2020–2025 before decreasing to zero by 2035–2045.[12]

2.3 International Energy Agency (IEA)

The Sustainable Development Scenario (SDS) published by the International Energy Agency (IEA) in 2019 is the most ambitious energy system scenario developed by the IEA. It is intended to be consistent with a two-thirds probability of limiting the temperature rise to 1.8˚C, and an even chance of limiting the temperature rise to 1.65˚C.[13]

The SDS explicitly places climate change mitigation alongside sustainable development and efforts to eradicate poverty, including through energy access. The scenario includes a strong drive towards both on-grid and off-grid electrification and requires an annual $1.3 trillion investment in the power sector between 2018 and 2050. The IEA estimates only around 3 per cent of this will be in fossil fuel plants without CCS. Most of the $1.3 trillion per annum is required for renewables (46 per cent) and power networks (44 per cent).[14] By 2050, the global power sector is mostly decarbonised, with 94 per cent of total worldwide generation coming from low carbon sources, principally wind, solar, hydro and nuclear.

In the SDS, gas power generation increases globally through to the late 2020s, due to its use as a flexible transition fuel. From that point onwards it declines as renewable costs continue to fall and flexibility needs are increasingly met from battery storage and other methods. By 2040, natural gas provides just 13 per cent of Africa's total power generation demand and 17 per cent of total generation capacity, while in India it provides 19 per cent of total power generation and 8 per cent of total capacity.

Other IEA scenarios which are not explicitly tied to the temperature goals of the Paris Agreement – but which nonetheless represent lower emission pathways than current trajectories – include a more substantial ongoing role for natural gas in the power sector. The IEA's 'Africa Case', which aims to meet the objectives of the African Union's *Agenda 2063* (including rapid economic development with full energy access), has gas electricity increasing from 345TWh in 2018 to 850TWh in 2040.[15]

2.4 Nationally Determined Contributions and long-term low GHG emissions development strategies

A key mechanism under the Paris Agreement is for each country to submit a Nationally Determined Contribution (NDC) setting out its GHG emissions targets and planned mitigation actions. At the time of writing, 186 countries have submitted an NDC.[16] These generally do not extend beyond 2030, and many countries are expected to submit enhanced NDCs by the COP26 conference in 2021. In addition, under Article 4 of the Paris Agreement, countries should strive to develop long-term low emission development strategies. At the time of writing, fewer than 20 countries have submitted these strategies.[17]

According to the IPCC, the aggregate ambition embodied by these NDCs is not compatible with 1.5˚C pathways. Estimates by other organisations suggest current pledges, even if delivered in full, are likely to result in warming of 3˚C above pre-industrial levels.[18] The Paris Agreement does, however, include a mechanism for countries to increase their level of ambition over time through a five-year cycle of NDC updates, facilitative dialogues and global stocktakes of mitigation efforts. The first of these global stocktakes is planned for 2023.

12 Regional data on gas use for electricity (with and without CCS) in five 1.5C aligned pathways from the IAMC Scenario Explorer hosted by the International Institute for Applied Systems Analysis (IIASA). This database was created to support the IPCC's Special Report on 1.5C and is available online. The five pathways reviewed were developed using the REMIND-MAgPIE Integrated Assessment Model with further details and data provided in Bertram et al (2018) Targeted policies can compensate most of the increased sustainability risks in 1.5C mitigation scenarios, Environmental Research Letters, Vol 13, No. 6. For further related information see also: Luderer et al (2018) Residual fossil CO_2 emissions in 1.5–2C pathways. Nature Climate Change 8, 626–633(2018).

13 IEA: World Energy Model, Sustainable Development Scenario. The SDS is presented in detail in the IEA's 2019 *World Energy Outlook* report, with regional datasets provided as appendices.

14 These figures are for the power system only. Total energy system investment between now and 2050 will be much higher (the IPCC 1.5˚C report suggests in excess of $3 trillion annually).

15 The Africa Case is also presented in the IEA's 2019 World Energy Outlook report.

16 NDC Registry (interim).

17 United Nations Climate Change: Communication of long-term strategies.

18 Climate Action Tracker: Warming projections global update (December 2018).

2.5 Implications for natural gas power plant investments

This evidence points to three overarching implications for natural gas power plant investments:

1. **Beyond 2050** – natural gas power plants operating after 2050 that continue to emit CO_2 (without CCS or without having transitioned to a low carbon gas such as sustainable biomethane or hydrogen) are likely to be misaligned with the Paris Agreement.
2. **Between 2020 and 2050** – the small remaining global carbon budget and rapid reduction in global emissions required for 1.5°C implies a globally limited role for new gas plants over the next two decades, with gas plants transitioning over time from providing baseload and mid-merit power to providing peaking capacity and system services. The timing of the transition depends on the individual starting point and the broader potential of each individual country. This, in turn, suggests gas plants without CCS can only be considered as 'Paris-aligned' if they are the only viable option for providing essential supply and system services' in a context where low carbon technologies are being pursued alongside a clear shift away from higher carbon fossil fuels such as coal and HFO.
3. **Transition risk** – investments in gas-fired power plants carry transition risk which must be considered. For example, costs could increase, revenues and financing could be constrained if and when governments implement policies consistent with the Paris Agreement, or by rapid changes in market conditions. These risks may be managed with careful consideration of gas power plant investments against potential changes to policy, regulation and contracts, market conditions (including financing appetite) and emerging or competitor technologies.

03

How to use this guidance note

The quadrant template in Figure 3.1 shows how this guidance note should be used as part of our overall investment screening process. Once these questions have been answered, a decision will determine whether the proposed investment is considered aligned with the 1.5˚C temperature goal and whether there are likely to be acceptable levels of transition risk. If this decision is positive, we will invest subject to our internal investment process. If this decision is negative, we will not invest in the opportunity in its current form.

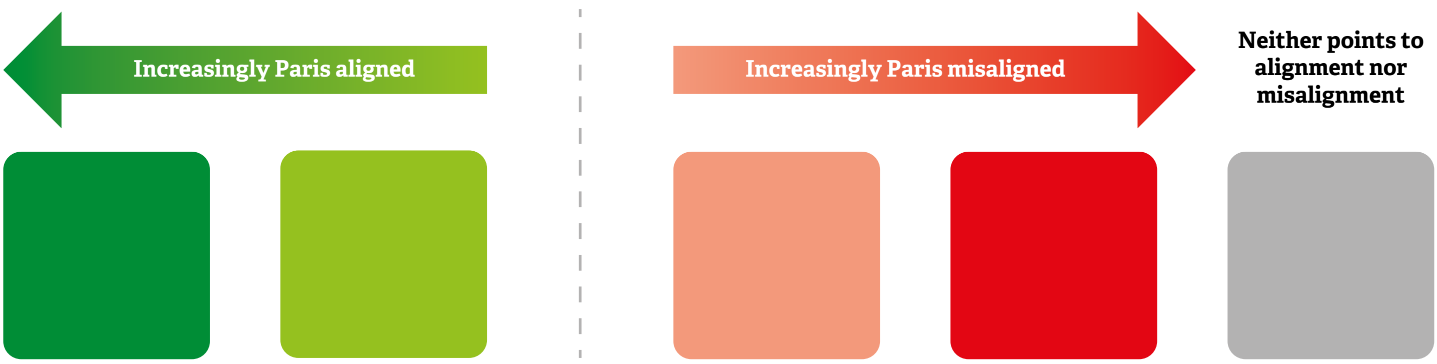
The indicators in Chapter 4 provide guiding principles to support this framework. We currently do not take indicator 6 (section 4.3.2) into account, given long-term decarbonisation plans do not yet exist in most of the countries in which we operate. However, this indicator will become more relevant as part of our overall assessment once long-term decarbonisation plans have been submitted and developed, as required by the Paris Agreement.

It should be noted that the task of applying the indicators in Chapters 4 and 5 will normally be based on a combination of project information, speaking to utilities and 'on-the-ground' stakeholders as well as exercising professional judgement. Some level of uncertainty will exist.

We would only pursue a gas project if we felt it was justified by the development impact (DI) case –hence the inclusion of DI within the quadrant. This assessment will follow our current approach to assessing impact and will look at supply/demand, quantify the impact we expect to have on forward jobs and consumers reached, and consider the affordability of that power.

Figure 3.1: Gas to power selection tool

Project name:



Asset level

1. Reasonable alternatives assessment: Are there any alternative lower carbon solutions that could feasibly be implemented instead of the gas power plant – taking into account cost, timelines and any other considerations?

2. Carbon lock-in risk: asset lifetime and long-term emissions profile: Do PPA/concession/fuel supply agreements end before 2050? If before 2050, under what circumstances can the asset continue operating after the end dates?

If after 2050, how can we get comfort that by 2050 a switch to a low carbon fuel or retrofitting with CCS or operation for ancillary services only will occur or else the plant will cease production?

3. Lowest emission technology: What is the emissions intensity (gCO_2/kWh) of the proposed plant and is the plant the least-emitting gas technology option for the size and role of project requested by the utility within a reasonable cost differential?

4.Operating Regime: Do design and project agreements allow for the operating regime to be increasingly flexible over time (technologically/contractually/economically) and what assumptions are made about the plant's use over time?

5. Replacement of higher carbon assets: Is the gas plant replacing a current higher carbon source (defined as coal, HFO, otherwise flared gas or a less efficient gas plant)?[19]

Other opportunities: What other opportunities are there for the proposed investment in climate terms (e.g. to transition over time to use CCS and/or use lower carbon fuels such as synthetic gas or hydrogen and/or have some other climate benefit?)

Development Impact

- Is the power needed? Quality matters here as well as the quantity (such as providing reliable/dispatchable power, diversifying the generation mix and providing energy security).
- How many electricity-enabled jobs is the project expected to create in the economy and how many consumers are expected to benefit?
- Is this a 'least-cost' option for the country in question?
- Are there any other development impact considerations?

19 Absence of displacement does not necessarily point to misalignment and so would be marked as grey.

System level

DECISION

6. Role of gas in the country's NDC: What is the role of gas in the country's mitigation efforts outlined in its Nationally Determined Contribution?[20]

7. Pathway development: Do credible Paris-aligned development pathways for a country's economy and electricity system exist and does this gas plant fit with those?[21]

8. Pathway adoption: Has the government shown a clear commitment to low-carbon pathways via targets, commitments, financial incentives, institutional framework? This should include renewable aspirations and plans for high carbon assets.

9. Pathway implementation: What has been done in practice? Evidence of the current and credibly planned deployment rates for low carbon infrastructure build on the one hand and high carbon assets on the other.

10. Meeting unserved demand: Does the country's demand growth profile and unserved demand require gas even with ambitious renewable deployment in order to meet demand?[22]

11. Grid stability: Has the utility experienced (or is the utility likely to experience) challenges in integrating intermittent renewable projects into the energy mix, and is gas needed to solve these?[23]

Transition Investment Risk

- Has the due diligence and Investment Committee process for the deal considered the exposure of the project to (i) **policy/regulatory risks** (potentially increasing costs or constraining revenues and financing) and (ii) **technology** and **market** risks (potentially changing the need/role/commercial importance of the plant over time), and concluded, together with the mitigants (contractual, commercial and otherwise) to these risks, that the residual risks are tenable?
- Has the project been considered within a wider strategic framework where the contribution of gas plant to overall **reputational and sentiment** risks (including future investor appetite and valuation at a portfolio level) is considered?

20 If the role of gas is not defined either way in a country's NDC, this will be marked as grey.

21 The absence of a long-term decarbonisation plan is not considered as an indication of misalignment at this point, given the majority of countries have not yet developed long-term decarbonisation plans.

22 If this indicator would otherwise have been light red or red but Indicator 11 (Grid stability) is green or light green, the light red or red indicator will be changed to grey (in other words, a plant does not need to both meet unserved demand and be needed for grid stability. It is more Paris-aligned if it does both, but should not necessarily be misaligned if it only does one and not the other).

23 As per footnote 22: grey will be used where Indicator 10 (Meeting unserved demand) is green or light green but this Indicator 11 would otherwise have been red or light red.

04

Compatibility with Paris-aligned decarbonisation pathways

4.1 Overview of indicator framework

Reaching the Paris Agreement's temperature goals requires the global energy system to be transformed by 2050. While a rapid low carbon transition is underway, the most carbon-intensive fossil fuels (such as coal and HFO) must be urgently phased out, and the use of natural gas limited to situations where it is the only viable option for providing power and essential services whilst a rapid low carbon transition is underway. Our framework includes system and asset level indicators and a transition risk indicator.

- The **asset level indicators** focus on the specific characteristics and circumstances of an asset. They provide a framework to understand whether there are any lower carbon alternatives to the proposed investment and whether the asset's timescales, operational regime and contractual terms are aligned with the role gas is expected to play in Paris-aligned pathways. These pathways depend on the individual starting point and broader potential of each individual country.
- The **system level indicators** focus on whether a jurisdiction understands and is committed to a low carbon pathway for its electricity system, and whether the role for gas power plants is understood in this context. Having high confidence that a gas plant is Paris-aligned demands an assessment of a jurisdiction's electricity *system*, not just the asset itself.

  In cases where a gas plant is expected to provide substantial amounts of power and system services to more than one jurisdiction – such as via interconnectors within the Western African Power Pool (WAPP) or Southern Africa Power Pool (SAPP) – these system level indicators may need to be applied flexibly to consider a broader geographical scale. For example, if a plant in one country provides essential services to support intermittent renewables in a neighbouring country, this should be taken into account.

  At present, many of our target countries do not have detailed long-term Paris-aligned pathways, either in development or being adopted and implemented. We expect this will change, but for now an assessment of the system level indictors may not yield a conclusive answer, reinforcing the need for the asset level assessment. Also, due to capacity and institutional constraints in some countries, there may not always be a fully documented or written evidence base. In such circumstances, it may be appropriate to take into account more informal sources, such as policy announcements or discussions with senior policy makers and politicians.
- The final **transition risk indicator** draws on the preceding system and asset level assessments, and provides an indication of the exposure of the proposed investment to policy, market and technology risks associated with a low carbon transition, as well as the global investment context.

The sections below provide a description of each indicator, along with a summary of the type of evidence that can be used to assess the proposed investment, using a sliding scale of risk. At the asset level and potentially system level, there may be opportunities to influence the investment such that confidence in Paris alignment can improve.

The ultimate decision as to whether an investment is aligned with the Paris Agreement should draw on the aggregate assessment of all the indicators used, as well as the development impact context, and will be subjective. In many cases, the information upon which a decision is based will be a matter of judgment. The indicator framework and scoring matrix will provide a clear rationale and transparent evidence base to support decision making.

4.2 Asset level indicators

4.2.1 Indicator 1 – Reasonable alternatives assessment

This indicator considers whether there are any reasonable lower carbon alternatives to the proposed gas power plant investment. To determine this, the most likely alternative(s) should be identified and then compared to the gas power plant, using the criteria identified below.

A key challenge will be determining whether an alternative can be considered 'reasonable' or not. To make this judgement, it will be necessary to consider the key differences between the gas asset and the alternatives, and then evaluate whether these differences are of material importance for the jurisdiction's electricity system and its local context.

If there is a reasonable alternative; the gas plant can be considered as misaligned with Paris. If there is no reasonable alternative, this points to potential Paris alignment.

This will consider some of the following criteria as appropriate. This list can be amended and updated as required on a case-by-case basis:

- **Cost:** is there a substantial cost differential between options for a similar level of service?
- **Electricity supply:** how does each alternative compare in terms of supplying electricity to meet the current unmet or future demand? How reliably can each alternative do this?
- **System services:** how does each option compare in terms of providing essential system services such as balancing, voltage management and inertia?
- **Greenhouse gas emissions:** do the identified alternatives deliver substantial reductions in greenhouse gas emissions compared to the proposed investment?
- **Networks:** what are the impacts on electricity transmission networks?
- **Timescales and implementation:** is there a substantial difference in timescales and implementation for plant commissioning?
- **Foreign exchange:** are there impacts on balance of payments or foreign exchange reserves?
- **Environmental and social impacts and other externalities:** are there significant impacts associated with each option?
- **Externalities:** has the externality of the carbon emissions for the respective country been considered?
- **Land availability:** are there any land constraints that may favour one option over another?

Box 1 – Low carbon alternatives to natural gas power plants

In some cases, there may be the potential to deploy dispatchable or baseload low carbon capacity – such as geothermal, biomass, hydro and concentrated solar power – as an alternative to gas plants. However, these opportunities may be limited in some of our target markets. More generally, utility-scale deployment of intermittent renewables such as wind and solar is increasingly cost-competitive with fossil fuel generation, and can be coupled with other technologies to provide reliable power for certain uses and periods of time. Many of our geographies have high levels of untapped solar and wind resource.

Alternatives based on intermittent renewables are likely to be particularly relevant for comparison against a natural gas power plant depending on the plant's role:

- In some situations, stand-alone large-scale wind or solar can provide substantial amounts of electricity to meet demand, while being balanced by other assets and the wider grid.
- In other situations, there will be integrated low carbon solutions that use wind or solar to provide most of the required electricity and a combination of storage (such as batteries) and reciprocating engines or aeroderivative gas turbines operating at very low annual load factors to manage periods of low or no renewable output.
- Over time, we would expect these integrated alternatives to include demand-side response measures, targeted network investments and synchronous condensers to provide inertia.

These alternatives do, however, have limitations. For example, there may be grid stability issues once a certain level of intermittent renewables has been reached (and, in some developing market grid contexts, once any level of intermittent renewables has been reached). There may also be a system requirement for services such as inertia which cannot be provided by solar, wind or batteries. There may also be cost implications or other constraints (such as land availability) in terms of potential environmental and social impacts.

4.2.2 Indicator 2 – Carbon lock-in risk: asset lifetime and long-term emissions profile

This indicator presents how the potential risk of locking-in carbon emissions is assessed in the investment selection process, by considering whether the asset will continue to be in operation beyond 2050 and, if so, whether it will continue to emit CO_2. To assess this, it is necessary to understand the terms of the power purchase agreement (PPA) and the circumstances in which operation beyond 2050 is possible.

As outlined in Chapter 2, the IPCC's work suggests that achieving the 1.5°C goal requires the global electricity system to be almost totally decarbonised by 2050. This implies that power plants still emitting CO_2 after this date will not be 'Paris-aligned' other than in exceptional circumstances.

If an asset's PPA and other agreements end before 2050, this indicates potential Paris alignment. In some cases, there can be contractual terms around end of life, absent agreements to the contrary, that disincentivise asset life extensions. This would be effective in reducing the risk the plant will continue to operate and emit after the PPA end date, although legal frameworks in different countries (for example, requirements to transfer assets back to host governments) may preclude this. Beyond the PPA period, it will be for host governments to decide in the context of their specific Paris Agreement obligations how any residual plant will continue, and if so the operating regime or abatement, for example carbon capture and storage (CCS) considered appropriate.

If the PPA and other agreements indicate the plant will continue to operate beyond 2050, this points to misalignment with Paris, unless by 2050 the plant:

- Will switch to a low carbon fuel such as sustainably-sourced biomethane or hydrogen produced via low-carbon production techniques, such as electrolysis with renewable power; or
- Will be retrofitted with CCS technology; or
- Will be operated for ancillary services where there are no feasible alternative lower carbon solutions available at acceptable costs; or
- Will be able to cease production if any of the above criteria cannot be achieved.

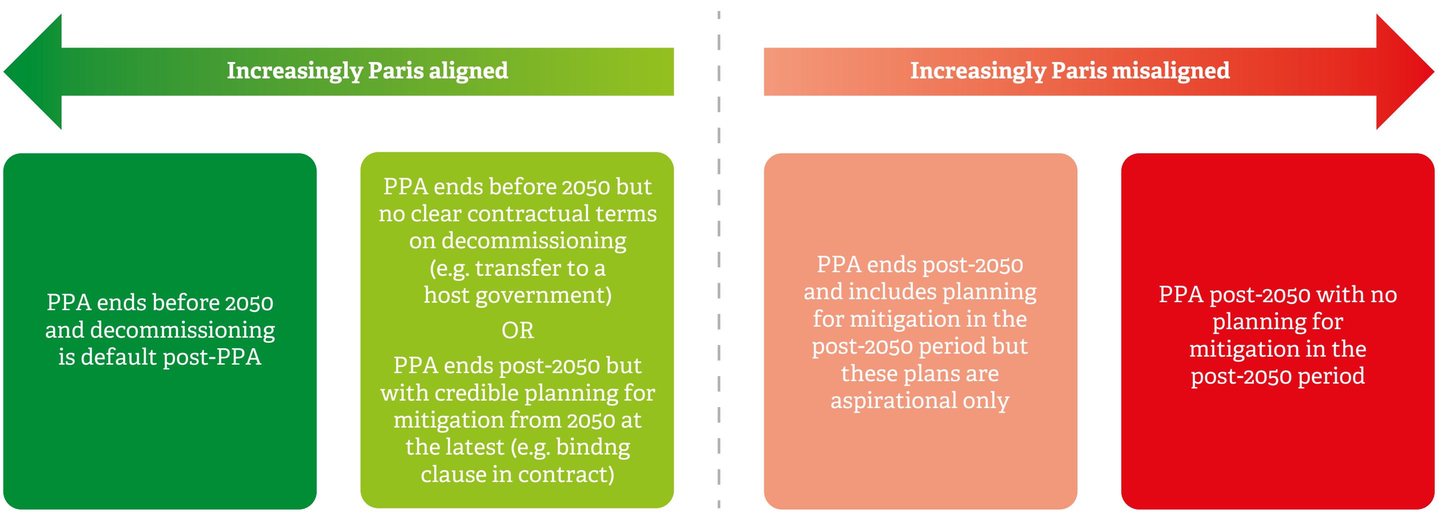
To assess this indicator, the following issues and questions should be considered:

- What are the end dates for the PPA, concession agreement and fuel supply agreement? Are there any unilateral extension clauses?
- Under what circumstances can an asset continue operating after the PPA or concession end dates?

If the PPA extends beyond 2050, how can we get comfort that the switch to a low carbon fuel, retrofitting with CCS, operation with ancillary services, or ceasing production will occur?

Figure 4.1 summarises a range of possible scenarios relating to asset lifetime and long-term emissions profiles, and how these scenarios relate to alignment with Paris.

Figure 4.1: Asset lifetime and emissions profile as an indicator of Paris alignment



4.2.3 Indicator 3 – Lowest emissions technology

An important consideration is that the lowest emissions technology is selected, in order to consider whether the plant is the least-emitting gas technology option for the size and role of project requested by the utility, within a reasonable cost differential.

To allow comparison with the IFC benchmarks (gCO_2/kWh):[24]

- **<300MWe**
  - CCGT: 361–488
  - Simple cycle: 448–673
  - Boiler: No data available
  - Reciprocating engine: 412–531
- **≥300MWe**
  - CCGT: 325–439
  - Simple cycle: 483–645
  - Boiler: 481–505
  - Reciprocating engine: No data available

For projects where the emissions intensity is outside of the range for the technology identified, we will investigate (with the sponsor) opportunities for alternative gas technologies or the potential use of lower carbon fuels.

4.2.4 Indicator 4 – Operational regime

This indicator considers whether the operational regime of the asset is aligned with the role natural gas power plants are expected to play in Paris-aligned pathways i.e. will the plant be increasingly used over time to manage grid challenges and support a rapid low-carbon transition? To help determine this, the proposed operational regime of the asset should be assessed, along with the level of technology and contractual flexibility, to allow for a changing operational regime as a jurisdiction's broader energy system requirements evolve over time.

Two factors may point to misalignment with Paris temperature goals:

- If a gas power plant is intended to be used over its operational lifetime primarily for baseload generation (unless evidence suggests ongoing baseload operation is the only viable option to meet unserved demand and provide grid services at the system level – refer to the system level indicators for more guidance on this).
- If there is limited flexibility for the plant to transition away from baseload towards mid-merit or peaking generation over time (backing-up intermittent renewables and providing essential grid support services in the transition period to 2050).

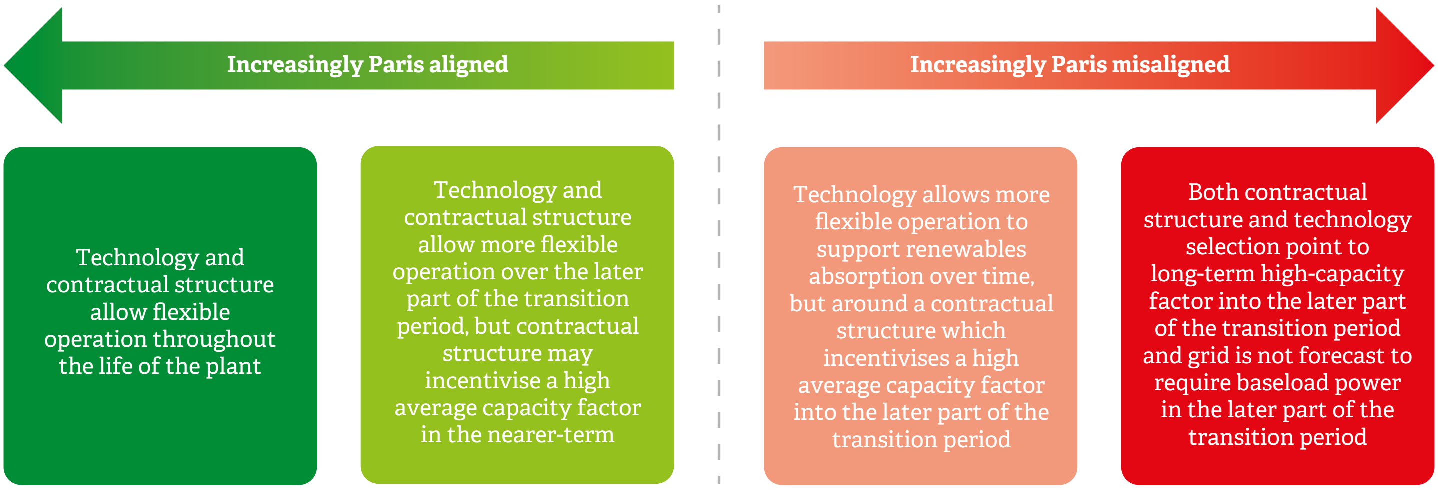
The following issues and questions should be considered:

- Operational regime specified or incentivised by the PPA – for example, do the terms of the PPA specify a flexible peaking or mid-merit regime, or lock-in baseload for the duration of the contract? Does the tariff structure enable flexible use (such as the PPA including both capacity and energy payments)?
- Financial model – what assumptions regarding long-term operation are required to make the project investable?
- Fuel supply contract terms – is there a long-term take-or-pay fuel supply contract, perhaps tied to liquified natural gas (LNG) facilities, that implies less flexible future use over time? Is there an opportunity to change the fuel that the plant uses to a lower carbon alternative?
- Plant technology – the use of open cycle gas turbines (OCGT) or reciprocating engine technology generally points towards a flexible operational regime, albeit less efficient. However, in reality there is also a risk that lower gas prices and/or implementation delays to other in-country projects and the undeveloped nature of a grid will result in more carbon-intensive technologies like OCGT being used for more than just peaking or back-up capacity. The use of new CCGT technology can point to mid-merit or baseload operation. In which case it will be important to consider medium-term grid needs, as well as the turbine class and technical specification as an indicator of potential to transition down the merit order over time all in the context of the commercial and contractual structure (for example, if the plant will be able to transition once capital costs are repaid). Overall, it will be important that the most carbon efficient technology is used for the proposed operational regime in the context of the system level requirements.

Figure 4.2 summarises how these contractual and technical characteristics can provide an indication of an asset's operational regime and its potential Paris alignment.

24 The assessor should refer to IFC EHS guidelines for thermal power plants (2017) (Draft for second public consultation) (see Table 4). The accompanying notes to Table 4 should be used.

Figure 4.2: Operational regime factors as an indicator of Paris alignment



4.2.5 Indicator 5 – Replacement of high carbon assets

This indicator considers whether the gas power plant is likely to operate in place of a higher carbon alternative such as coal, HFO, otherwise flared gas or a less efficient gas plant. If so, emissions will be lower than the counterfactual and provided there are no other reasonable lower carbon alternatives to gas, this points towards Paris alignment. However, in the instance where there is no carbon that will be displaced (for example, a hydro-based grid that is suffering the effect of climate change drought and needs a reliable power source) this does not point to Paris misalignment if other indicators suggest the plant is Paris-aligned (and so would be marked as 'grey' in the indicators below).

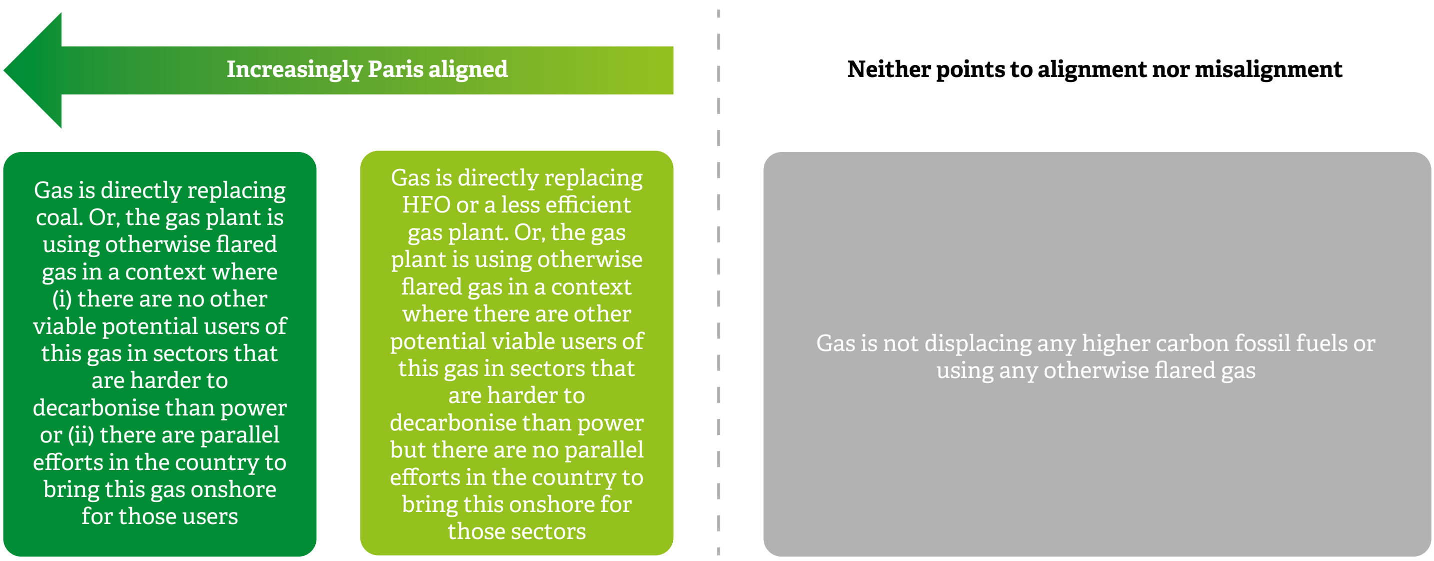
It is important to note here that a gas power plant cannot be considered Paris-aligned simply because it replaces coal or HFO. While gas may be lower carbon it is not low carbon, and can only be considered Paris-aligned where it is the only viable option for providing essential power supply and system services (in the context of the system level indicators) and/or a reasonable alternatives assessment.

There are a number of circumstances that could indicate gas being used in place of higher carbon alternatives (defined as coal, HFO, otherwise flared gas or a less efficient gas plant):

- The gas plant is directly replacing current higher carbon alternatives.
- The jurisdiction has a programme for the replacement and retirement of higher carbon alternatives.
- The jurisdiction has access to higher carbon alternatives but regulatory or market conditions mean gas plants are now the preferred option.

Figure 4.3 summarises the circumstances in which a gas asset can be considered to be replacing higher carbon assets in a way which aligns with the Paris Agreement.

Figure 4.3: Replacement of high carbon assets as an indicator of Paris alignment



4.3 System level indicators

4.3.1 Indicator 6 – Role of gas in the Nationally Determined Contribution

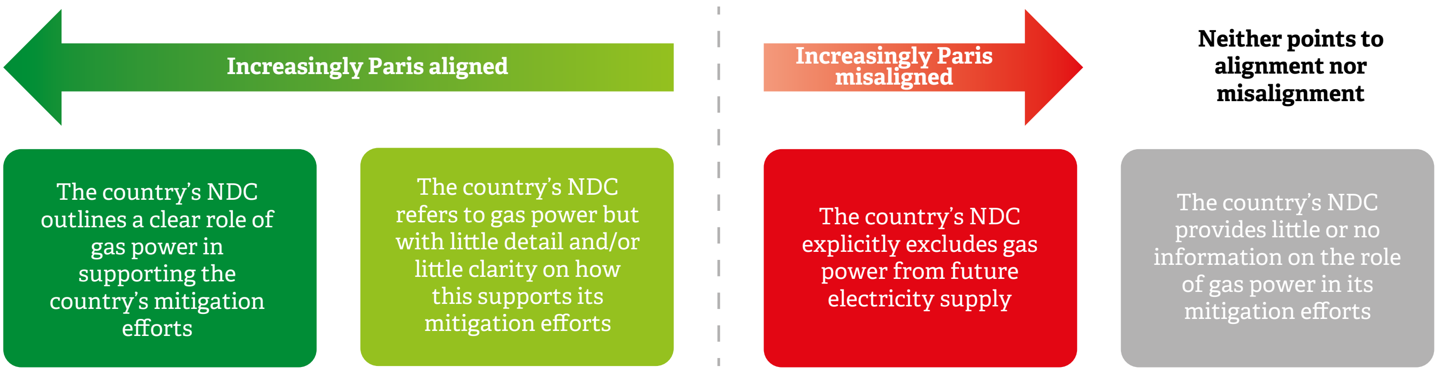
Nationally determined contributions (NDCs) are at the heart of the Paris Agreement and the achievement of its long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, paragraph 2) requires each party to prepare, communicate and maintain their post-2020 climate actions successive NDCs that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions. Together, these climate actions determine whether the world achieves the long-term goals of the Paris Agreement. It is understood that the peaking of emissions will take longer for developing country parties, and that emission reductions are undertaken on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty, which are critical development priorities for many developing countries. Each climate plan reflects the country's ambition for reducing emissions, taking into account its domestic circumstances and capabilities.

Assessing the role of gas power in a country's NDC is therefore an important starting point. It is worth noting that just because a country's NDC refers to the role of gas power, it does not automatically mean Paris alignment, as most NDCs are currently not aligned with the Paris temperature goal of 1.5˚C. Paris alignment is about how to reach net zero emissions by 2050, whereas NDCs only outline mitigation ambition until 2030, and aggregating current NDCs would result in about 3˚C warming by 2100.

In order to address the mismatch of NDC ambitions with the long-term temperature goals of the Paris Agreement, it includes a 'ratchet up mechanism' in which NDCs are increased every five years to make them more ambitious and align them over time with a 1.5 ˚C scenario.

Figure 4.4 summarises how the country's NDC can provide an indication of the systems potential Paris alignment.

Figure 4.4: A country's NDC as an indicator of Paris alignment



4.3.2 Indicator 7 – Paris pathway development

The first indicator considers the extent to which detailed, credible net zero pathways have been developed for the jurisdiction under consideration. These pathways may or may not have been directly developed or adopted by the government itself but either way they are important in themselves marker of the jurisdiction's direction of travel, and as a basis for understanding the legitimate role of gas power plants during a net zero transition (see Indicators 10 and 11).

As of today, where a long-term decarbonisation plan does not exist, we will not take this indicator into account, given this is the case in most countries. However, it will become more relevant as part of the overall assessment once long-term decarbonisation plans have been submitted and developed, as required by the Paris Agreement. We will review relevant plans developed outside of the Paris Agreement in the context of Indicator 8.

At a broad level, there are two types of long-term pathways relevant for the purposes of this guidance note (see Table 4.1 for a more detailed summary):

- **Long-term low emission national development strategies** that cover all major sectors of the economy ,and demonstrate how future economic development will align with 1.5⁰C emissions trajectories (including global net-zero CO_2 emissions by 2050 and global net-zero GHG emissions in the second half of this century).
- **Least-cost electricity system expansion plans** that shows how a jurisdiction's electricity system can become decarbonised by 2050, taking into account future demand and increasing energy access.

To be credible, these pathways will probably have been developed by governments or other in-county or international non-governmental organisations (such as multilateral development banks). Ideally these pathways (or the accompanying evidence base) will set out how rapid deployment of low-carbon electricity generation can take place alongside the phase-out of high-carbon fossil fuels, while also considering grid stability and measures to increase demand-side efficiency, flexibility and storage. Where such pathways exist, they should be reviewed to determine the specific circumstances in which there is a role for gas power plants within the energy system.

Table 4.1: Description and examples of types of pathway

Pathway type	Description	Examples
Long-term low-emission economy-wide strategies	Ideally, these will cover all sectors of the economy, be explicitly aligned with a country's contribution to the Paris Agreement, be supported by a robust evidence base and be underpinned by comprehensive energy system-climate models, such as the Stockholm Environmental Institute's LEAP model. Such strategies may form the basis of a country's submission to the United Nations Framework Convention on Climate Change (UNFCCC) under Article 4 of the Paris Agreement (whereby countries should strive to develop long-term low GHG emission development strategies.[25] NDCs should also form part of the evidence reviewed here. These do not generally extend beyond 2030, and therefore cannot demonstrate a fully Paris-compliant pathway to 2050. However, many countries are expected to submit enhanced NDCs by COP26 in 2021. These should provide an important reference for understanding countries' ambition and direction of travel.	At the time of writing, fewer than 20 countries have submitted long-term strategies under the Paris Agreement.[26] This list does not currently include any of our target geographies and, in many cases, these strategies are high-level and not sufficiently ambitious to meet the Paris temperature goals. However, it is reasonable to expect more countries will develop long-term strategies that more closely align with the Paris Agreement, supported by initiatives such as the 2050 Pathways Platform and the NDC partnership.[27] Over time we expect that more countries would benefit from detailed national and regional decarbonisation pathways based on wide-ranging analysis, evidence and stakeholder engagement. An example from the UK would be the UK Committee on Climate Change's carbon budget and net-zero reports.
Long-term least-cost electricity system expansion plans	Ideally, these will be recent and undertaken by or on behalf of the host country government. These plans should be based on detailed electricity system modelling over decadal timescales with pathways optimised for cost, carbon, etc. They will consider rapid deployment of low-carbon electricity generation, the phase-out of high-carbon fuels, increased demand from improved energy access and the electrification of transport and other parts of the economy, grid stability issues and measures to increase demand side efficiency, flexibility and storage. They will identify the role of natural gas in providing essential services during a low-carbon transition.	A recent example of least-cost development plans includes Kenya's least-cost power development plan (2017–2037).

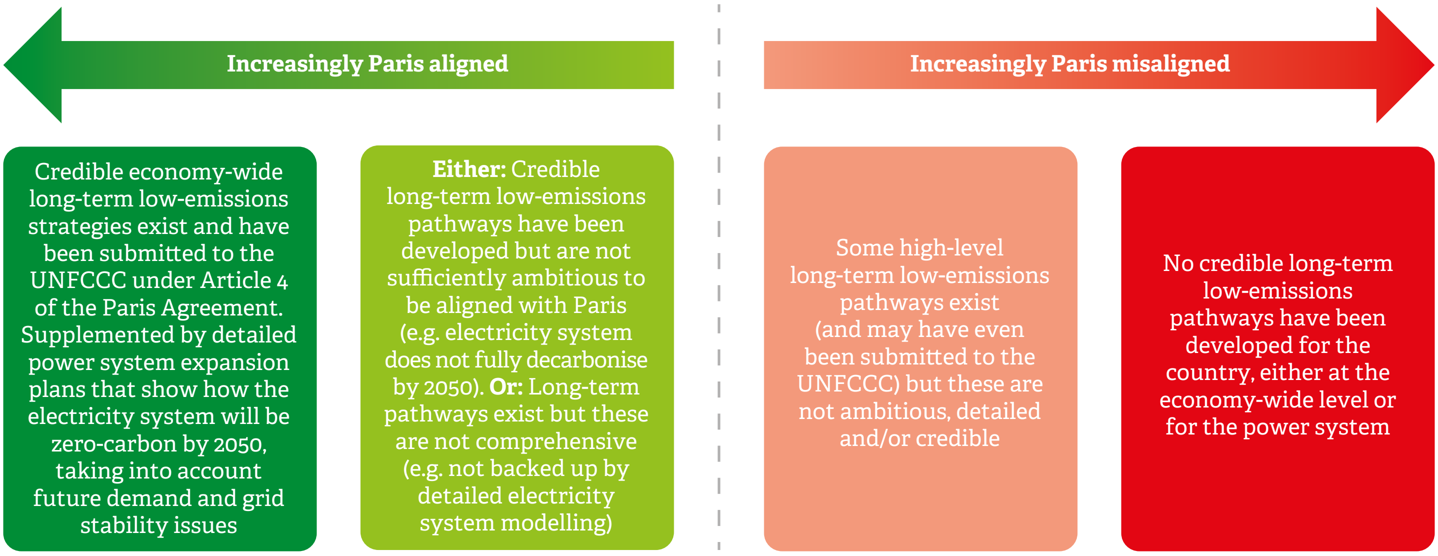
25 The COP, by its decision 1/CP 21, paragraph 35, invited parties to communicate by 2020 their long-term low GHG emission strategies in accordance with Article 4 of the Paris Agreement. See United Nations Climate Change – Communication of long-term strategies.

26 See United Nations Climate Change – Communication of long-term strategies.

27 See NCD Partnership and the 2050 Pathways Platform.

Figure 4.5 summarises how the existence and characteristics of long-term low emission pathways can be used as an indicator of a jurisdiction's alignment with Paris.

Figure 4.5: Existence and characteristics of low emissions pathways as an indicator of Paris alignment



4.3.3 Indicator 8 – Pathway adoption and Government support

This indicator considers the extent to which a jurisdiction's governing authorities are actively committed to supporting a net zero pathway. This is distinct from Indicator 1, because here we are looking for evidence that a government is using the tools at its disposal – such as legislation, regulation and financial incentives – to translate a long-term low-carbon plan into tangible near-term action. It is also possible that a government is putting in place a supportive framework for low-carbon development without having explicitly developed a low-carbon plan.

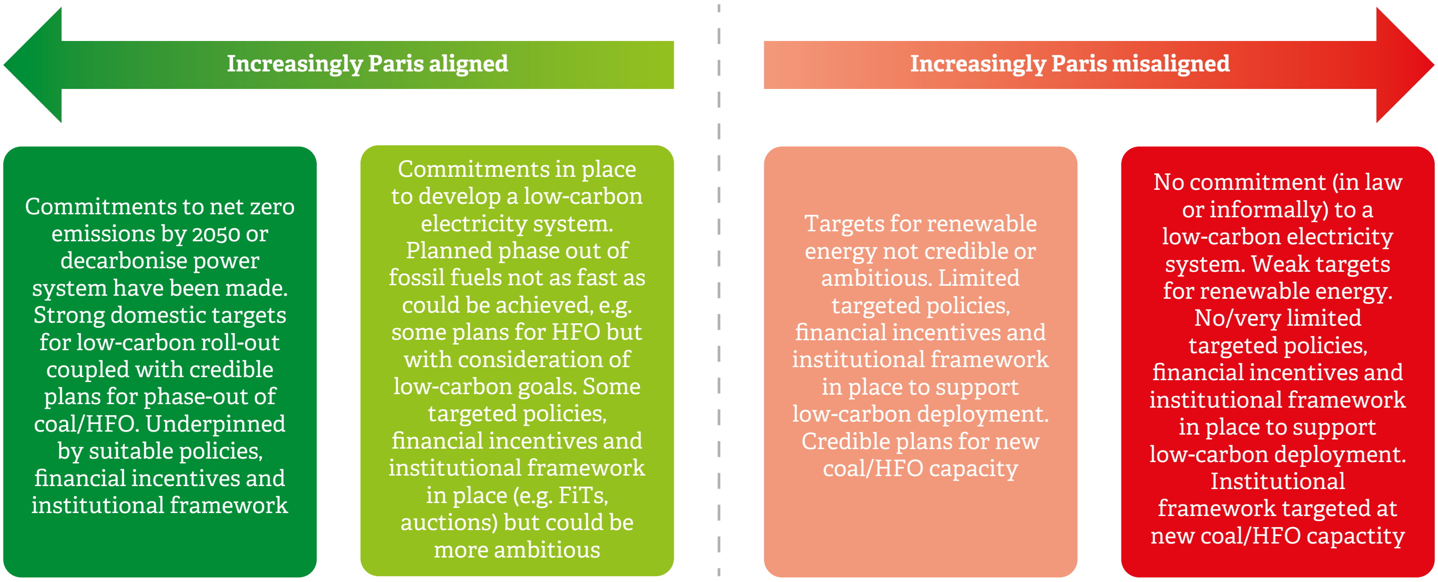
We recognise that some countries may have bespoke constraints related to the delivery of these plans, and we will take this into account when making our assessment.

To assess this indicator, following areas of potential government action, focused on the power sector, should be considered:

- **Commitments:** has the government made explicit commitments – either to domestic audiences (including parliaments or citizens) via strategies, legislation or policies; or to international institutions (such as UNFCCC) – that it intends to pursue ambitious low-emissions or net zero objectives?
- **Targets:** are there specific targets for the roll-out of low carbon technologies in the power sector (for example, renewable deployment targets) and the phase-out of high-carbon fossil fuels such as coal and HFO? Are these targets ambitious? Are they just aspirational or have they been enshrined in law or passed down to relevant stakeholders (such as utilities)?
- **Policies:** are there policies in place to support expansion and decarbonisation of the power sector, such as feed-in-tariffs (FiTs), renewable auctions, support for mini-grids and home solar systems? Are these policies supporting ambitious levels of low-carbon deployment?
- **Financial incentives:** are there other financial arrangements in place to disincentivise high carbon generation (such as carbon pricing) and to incentivise low carbon generation (such as tax breaks)?
- **Institutional framework:** Is there a suitable institutional framework in place or in development to attract investment and deliver low carbon infrastructure – for example utility regulation and market liberalisation to attract independent power producers (IPPs)?

Figure 4.6 summarises how government support for a net zero transition can be used as an indicator for alignment with Paris.[28]

Figure 4.6: Governmental support as an indicator of Paris alignment



4.3.4 Indicator 9 – Pathway implementation

This indicator considers the extent to which government support and other factors are leading to the physical roll-out of low carbon infrastructure and enabling measures. In the short term, while many jurisdictions are still in the early stages of developing low carbon plans, this will be a key area to assess in terms of a government's commitment to moving to a lower carbon transition.

We recognise that some countries may have bespoke constraints related to renewable resource or land availability, thereby restricting renewable deployment. We will take this into account when making our assessment.

Assessment of this indicator should involve the following considerations:

- **Build-out rates of low carbon infrastructure over the last 5–10 years:** are these in line with pathways that decarbonise the power system by 2050, or if not, are they ambitious?
- **Infrastructure pipeline:** what low carbon assets are either under construction or have reached financial close but are not yet operational?
- **All types of low-carbon generation capacity:** including renewables (firm and intermittent), nuclear, and in the future possibly other sources such as clean hydrogen and fossil fuels with CCS. Covering both utility and grid-scale capacity and community and residential scale installations.
- **Supporting infrastructure** required to facilitate low-carbon capacity, such as transmission and distribution network upgrades.
- **Other enabling measures** such as demand-side reduction and energy efficiency programmes (could be applied at residential, commercial, industrial sectors) and smart-grid roll-out.
- **Build-out rates for new coal and HFO generation capacity:** where this is occurring, it points to an overall infrastructure programme that is not aligned with Paris.

High confidence of Paris alignment for this indicator would include clear evidence that low-carbon infrastructure build is occurring in line with the levels required to decarbonise a jurisdiction's power system by 2050. However, where there is an absence of a robust evidence base that articulates what this Paris aligned rate of infrastructure build looks like, a key challenge will be evaluating the level of the country's actual progress. As with Indicator 8, this decision will be subjective, but can be framed by reference to studies that quantify deployment potential and by comparison with other countries (see Box 2).

28 International Renewable Energy Agency: Global energy transformation: A roadmap to 2050 (2019 edition).

Box 2 – What is an 'ambitious' level of renewable energy deployment?

Defining an ambitious renewable energy target, or level of deployment, is subjective and context-specific. When considering intermittent sources such as wind and solar, what constitutes an ambitious amount of capacity will depend on the overall size of a jurisdiction's grid, the country's resource potential, the availability of other forms of dispatchable generation such as hydro and gas and the need for (and availability of) non-kilowatt (kWh) grid support services.

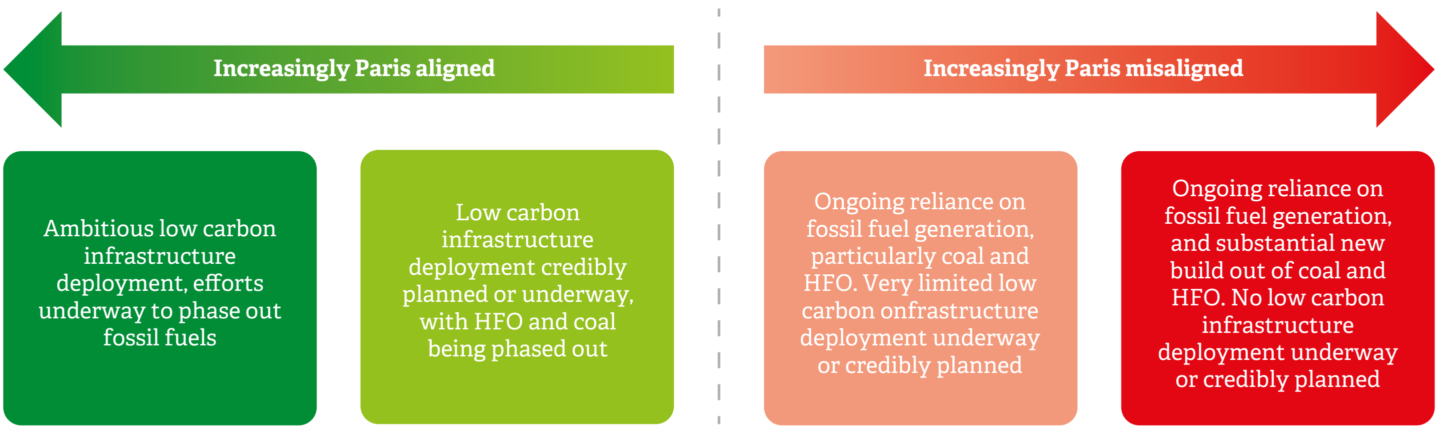
Ideally, a jurisdiction will have undertaken detailed grid expansion studies that provide a clear pathway to a zero-carbon power system by 2050, as outlined in the section on Indicator 1. If robust, these studies will provide specific guidance on the levels of low carbon generation and intermittent renewables that can be technically and economically deployed over time. These numbers can then be used as an 'ambitious' benchmark, acknowledging that there are likely to be institutional and financial constraints to consider too.

Without such studies in place, other sources can be used to indicate renewable energy potential. For example, IRENA's Remap programme has published a 2030 renewable energy roadmap for Africa, and a Renewable Energy Prospects report for India. Other useful sources include the IEA's Africa Energy Outlook 2019 ('Africa Case' scenario).

Senegal has prioritised the growth of its renewable sector, evidenced by legislation, including The Guidance on Renewable Energy (2010), which demonstrates the government's commitment to increase the proportion of renewable energy. To date, approximately 142MW of installed solar capacity has come online, with wind projects also under development. In 2020, renewables should account for 30 per cent of Senegal's total electricity mix.

Figure 4.7 summarises how levels of low-carbon infrastructure roll-out can be used as an indicator of a jurisdiction's alignment with Paris.

Figure 4.7: Levels of low carbon infrastructure roll-out as an indicator of Paris alignment



4.3.5 Indicators 10 and 11

These final two system level indicators flow from the preceding indicators and aim to summarise the electricity system requirement for natural gas power plants. Where there is a clear identified need for gas to maintain a stable grid and meet increasing demand that cannot be met by other lower carbon solutions, this points to potential Paris alignment. Where there is no clear need, this points to Paris misalignment

Gas power plants may have an important Paris-aligned system role in two main respects:

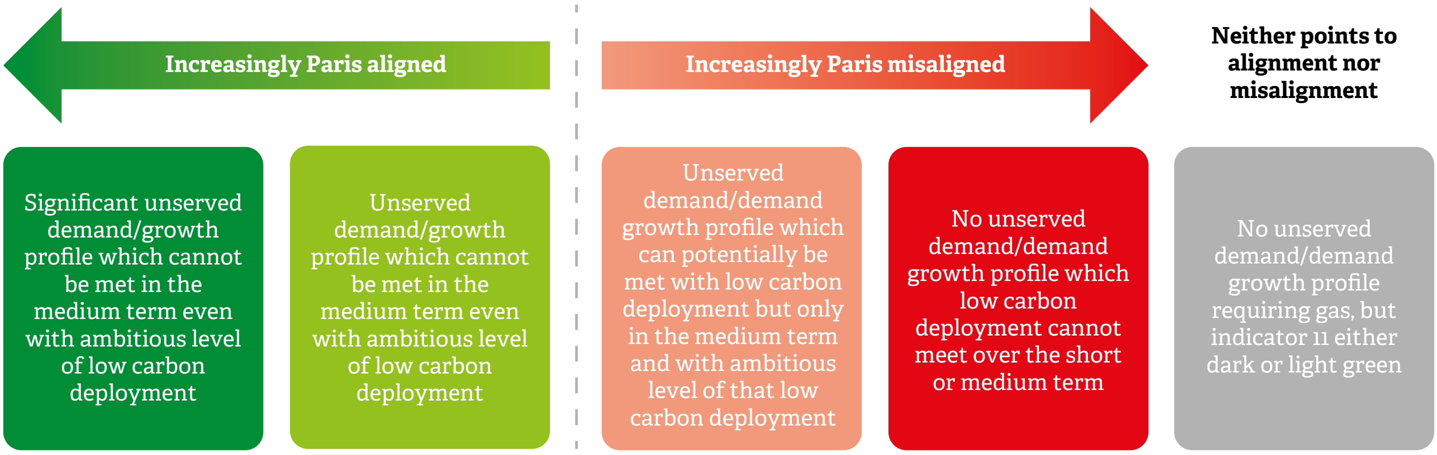
- Meeting unserved demand and demand growth
- Providing grid stability

4.3.5.1 Indicator 10 – Meeting unserved demand and demand growth

In many emerging economies and least-developed countries, there is a large amount of unserved demand and/or significant growth forecast (versus developed economies where demand may be flat or declining). Even with an ambitious deployment of low carbon capacity, there may still be a need for gas plants to help meet this demand in the short- to medium-term, or in anticipation of increases in demand.

It is important to give consideration to building out supply in anticipation of predicted increases in demand. Figure 4.8 sets out how meeting unserved demand and demand growth can be used as an indicator of Paris alignment.

Figure 4.8: Meeting unserved demand and demand growth as an indicator of Paris alignment



4.3.5.2 Indicator 11 – Variable renewable energy grid issues, system requirement for grid stability, flexibility and balancing

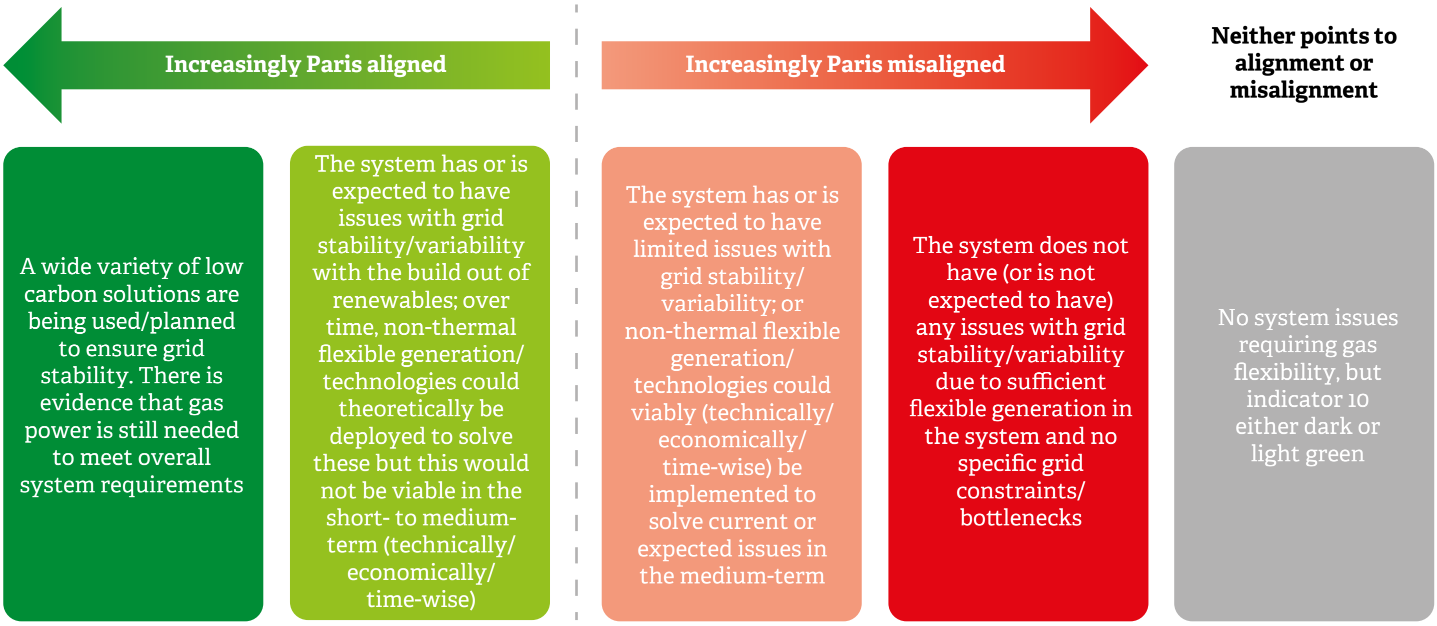
Operating power systems with increasingly high levels of wind and solar can be challenging, since this energy supply is intermittent and also does not offer inertia, which is required for system stability. Flexible gas plants can provide a solution to these challenges by flexible balancing generation, inertia and other system services. Other system requirements to consider include flexibility and ancillary services such as voltage control, frequency control and black start.

Ideally, the evidence base to understand these system requirements will be provided by the long-term pathway strategies and plans outlined in Indicator 7, particularly least-cost electricity system expansion plans designed to achieve decarbonisation by 2050. However, there may be other relevant sources of evidence ,such as power network studies and masterplans, as well as renewable energy integration studies and evidence from power system actors. We expect such analysis will be increasingly available in the coming years, as system operators and power procurers become more aware of system issues.

An important question here is whether the identified system requirements for natural gas can in fact be met by alternative lower carbon approaches. A detailed assessment of this point at the asset level is covered by Indicator 1. The issue to consider here is whether the above system level information is up-to-date and takes into account low carbon alternatives.

Figure 4.9 sets out how system requirements can be used as an indicator of Paris alignment.

Figure 4.9: System requirements as an indicator of Paris alignment



05

Transition risk

In addition to assessing the proposed investment against system and asset level indicators, transition risk also needs to be assessed. Indicator 9 considers the exposure of the proposed investment to policy, market and technology risks associated with a low carbon transition. This will in turn help to inform an assessment of the vulnerability of the anticipated future revenue stream, and support our reporting under the Taskforce on Climate Related Financial Disclosures (TCFD).[29]

Under TCFD, climate-related investment risks are split into two main types:

1. **Transition risks** associated with the transition to a low carbon economy.
2. **Physical risks** associated with the impacts of a changing change.

This indicator considers transition risks related to investments in natural gas power plants. These risks vary by technology, geography and investment type and include legal, regulatory, technical and market aspects that have the potential to lead to negative financial and/or reputational consequences.

Assessment of this indicator is likely to draw upon existing areas of our Investment Committee and due diligence procedures. This will include reviews of fuel supply contracts and power purchase agreements and, critically, the commercial logic of plants over time in an evolving energy market. As well as considering technological changes, reviews will also determine where policy and regulatory changes may potentially play a more prominent role, to the detriment of gas-fired power.

In this way, the transition risk indicator provides a consolidated metric on the exposure of the potential investment to risks associated with the transition to a net zero world, in line with TCFD recommendations.

Assessment of this indicator should consider the documents referred to below and issues, many of which will have been included in the analysis of Indicators 1–10 above. In general, the more transitional, flexible and Paris-aligned the plant, the more resilience it is likely to have in transition risk terms. However, consideration should also be given to aspects which are beyond country and asset level assessment, and which are dependent on changes at a global level. An example of this would include technology risks where predicted reductions in prices for renewable energy technologies and other emerging technologies (such as battery energy storage) at a global level could impact on merit order and the commercial sustainability of gas fired power plants in countries in which we invest. Issues to consider:

- Electricity sector plans for planned new power generation capacity; projections in demand for power and electrification strategy and targets, and comparison with realistic alternatives available.
- Renewable energy policies or targets and progress made towards meeting these, climate change policy and commitments, and potential future policy measures that may be introduced, such as carbon pricing.[30]

29 Chaired by Michael Bloomberg, TCFD "seeks to develop recommendations for voluntary climate-related financial disclosures that are consistent, comparable, reliable, clear, and efficient, and provide decision-useful information to lenders, insurers, and investors.". See: Recommendations of the Task Force for Climate Related Financial Disclosures.

30 See for example, World Bank, State and Trends of Carbon Pricing, published annually.

- Details of the power plant (including technology, installed capacity and expected annual power output), as well as key contracts, such as the PPA and gas supply contract.
- Market and cost assessments of new and emerging technologies.[31]
- Market considerations on gas pricing, whether the source price of gas is fixed or known by contract, and the impact of changing global gas prices in the future on the investment (especially in a scenario of potential global gas oversupply due to a rapid transition, but also in the context of potential future policy measures).
- How the investment is forecast to be recovered over time (payback period, realised returns over time) and in different scenarios.
- Contractual and other protections available in the event of unforeseeable future changes and the amount and level of cover (such as changes in law, termination clauses, insurance).

Transition risks should be assessed considering the following categories according to the TCFD guidelines:

- **Policy and regulatory risk:** policy changes could lead to increased operating costs or reduced revenues, where not otherwise mitigated.

  For example, at a simple level, increased reporting or insurance requirements on gas power plants could increase costs. More broadly, carbon pricing would have the effect of increasing operating costs. A carbon tax was introduced in South Africa in June 2019, and several countries in which we operate are considering carbon pricing as a tool to support achievement of NDC goals, including countries in East and West Africa and Asia.[32]

  Mitigants include contractual and insurance protections (for example, PPA structure with capacity payments, change in law protections to offset increased costs with increased revenues, termination provisions and contract insurance taken) as well as assessment of how investments are forecast to be recovered over time in different scenarios. In considering contractual protections, the impact of regulatory-driven cost changes or dispatch role of plant on the conclusions around merit order and alternatives, and over what potential timescale, is a factor which should be borne in mind (see below).

- **Market and technology risks:** a number of factors could lead to reductions in the forecast growth and changes in demand for electricity, and effects on the commercial importance of existing plants over time (in the unprecedented wider context of deflationary energy prices from the reduction in cost of solar and wind in particular). These could include (i) lower overall demand growth than anticipated (for example, from energy efficiency measures), even if many of the markets we operate in have low starting bases of energy consumption and are in a different position to more developed markets[33]; (ii) the roll-out of renewables with very low short-run marginal costs (potentially reducing the usage/role of a gas plant, to the extent not offset by increased demand for balancing and other non-kWh system services, which may increase as intermittent renewables are deployed and/or reductions in the cost of gas during long-term oversupply situations), and (iii) new competing technologies providing similar services becoming commercially viable over the lifetime of a gas plant.

  These risks can be mitigated, in the first instance contractually through a PPA, but merit order and commercial sustainability analysis are an important part of the investment screening process to ensure the long-term commercial logic beyond contractual protections.

- **Reputational and sentiment risks:** these risks relate to the potential future changing of attitudes towards gas in a rapid transition to net zero. They also include the impact on the way a business is viewed overall by stakeholders, as well as on the valuation/exit/refinancing of the gas investments (as equity investors and debt providers reduce their exposure to fossil fuel assets in a carbon-constrained world, the risk of not being able to exit/refinance or only exiting at a lower price may increase). Again, the greater the Paris alignment of the gas plant invested in (and the future logic of the plant within a transition), the lower the risk.[34] Other mitigants to the particular valuation/exit/refinancing risk can include the flexibility of the investment holding period.

  These reputational and sentiment risks are likely best evaluated at the portfolio level, rather than an individual asset level.

31 See for example Lazard, Levelized Cost of Energy and Levelized Cost of Storage, published annually and BNEF New Energy Outlook, published annually; the specific market application factors (such as grid costs and transportation costs) in the relevant markets.
32 World Bank Open Knowledge Repository: State and Trends of Carbon Pricing 2020.
33 In many of the geographies that we operate in, demand for power is projected to increase over the next 30 years, in line with electrification strategies (to achieve UN SDG7) and economic growth.
34 And the lower the risk of negative reputational views such as those which have accompanied coal fired generation. See: Overpaid and Underutilized: How Capacity Payments to Coal-Fired Power Plants Could Lock Indonesia into a High-Cost Electricity Future (IEEFA).

Glossary

BOO	Build, own and operate
BOOT	Build, own, operate and transfer
CCGT	Combined cycle gas turbine
CCS	Carbon capture and storage
CO_2	Carbon dioxide
ESDD	Environmental and social due diligence
ESIA	Environmental and social impact assessment
EU	European Union
FiT	Feed in Tariff
GHG	Greenhouse gas
IEA	International Energy Agency
IED	Industrial Emissions Directive
IPCC	Intergovernmental Panel on Climate Change Independent
IPP	power producer
kWh	Kilo watt hour
LDCs	Least developed countries
LNG	Liquified natural gas
NDC	Nationally determined contribution
NGO	Non-governmental organisations
NOx	Oxides of nitrogen
OCGT	Open cycle gas turbine
PPA	Power purchase agreement
SAPP	Southern Africa Power Pool
SDG	Sustainable Development Goal
SDS	Sustainable Development Scenario
TCFD	Task Force on Climate-related Financial Disclosures United
UNFCCC	Nations Framework Convention on Climate Change
VRE	Variable renewable energy
WAPP	Western African Power Pool
WRI	World Resources Institute

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