KPMG

Quarterly Brief

Renewable energy valuation in the global energy transition

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Dear Reader

Over the past years, a systematic shift has occurred in the world's stance on renewable energy. The need for a global energy transition, coupled with both increased governmental support and key technological advances, are hailing renewable energy as the next frontier and are fueling the embracement of and the optimistic investment in a sustainable future.

In the midst of the global energy crisis – with some of the highest energy costs in decades – this edition of the Quarterly Brief introduces renewable energy, discusses the factors contributing to the recent wave of activity in renewables as well as how to approach renewable energy valuation.

In this newsletter, we explore questions such as:

- What are the major renewable energy sources and what is their current position in the global energy mix?
- What has contributed to the recent wave in renewable energy activity and investment?
- What are the key factors to consider when performing valuations of renewable energy projects?

We look forward to discussing your questions regarding renewable energy valuation. As always, stay safe and healthy.

Yours faithfully

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The global energy transition

The significance of the global energy transition from fossil fuels to renewable sources is widely acknowledged. The imperative of the transition from a fossil fuel-reliant society to a sustainable one is generally appreciated as being not only a global warming concern but also caused by the nature of fossil fuels as, by definition, being finite resources, which will eventually become prohibitively expensive as they deplete.

As a society, we depend systemically on fossil fuel sources to maintain our way of life and difficult changes must be made so our most essential and common activities can continue without fossil fuels. For society to survive, we must continue to drive technological advances in order to surmount the formidable economic and societal obstacles in the way of a sustainable future.

Understanding renewable energy sources

Renewable energy flows come from three sources but manifest themselves in many forms. The three renewable energy flows are solar radiation, decay of radioactive materials in the Earth's crust (i.e., geo-thermal energy) and the gravitational interplay between the earth and moon (i.e., tidal energy). In this Quarterly Brief, we will focus on the first, solar radiation. While the other two renewable energy flows are important, much of the renewable energy sources in use today and most promising for the future arise from the solar radiation energy flow. From solar radiation, we derive the following key renewable energy sources (Smil 2016):

Wind power,

which converts solar radiation into electricity indirectly, is generated due to pressure differences resulting from temperature differentials on the Earth's surfaces

Hydro power,

which also converts solar radiation into electricity indirectly, but does so through the kinetic energy of streams, created by the sun-driven water cycle of evaporation, precipitation, and runoff

Solar power,

which directly converts solar energy into electricity through the use of solar photovoltaic ("PV") cells, also known as solar panels, as well as concentrated solar power ("CSP") which uses mirrors or lenses to concentrate solar energy to a single point for conversion

Biomass,

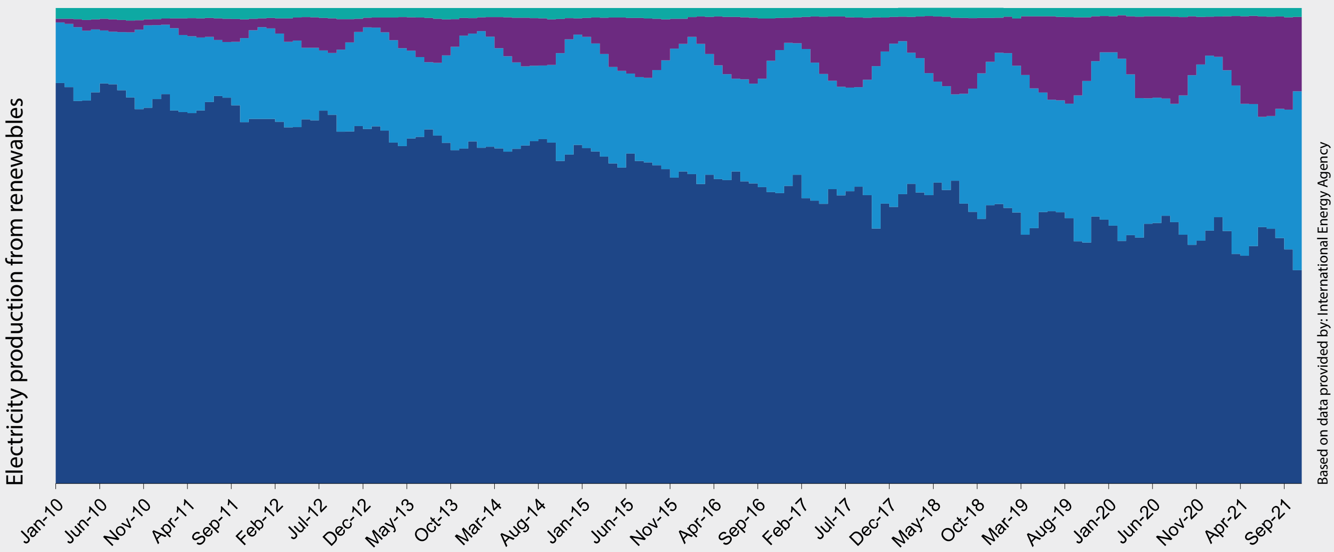
another form of renewable energy from solar radiation (via photosynthesis), is a form of combustible renewable energy and contributes a relatively minor portion to the global energy mix

As shown in Figure 1, these energy sources make up the bulk of electricity converted from renewable energy sources with hydro power, wind power and solar power making up 51%, 31% and 17%, respectively, of total electricity production from renewable sources on average in 2021 for OECD countries.

As part of the total energy mix from all sources, though, we observe that electricity generated from renewable sources continues to make up a minority of the total output when compared to fossil fuel sources, as shown in Figure 2. Despite this, we observe renewable sources contributing a significant portion at an accelerating pace.

Figure 1

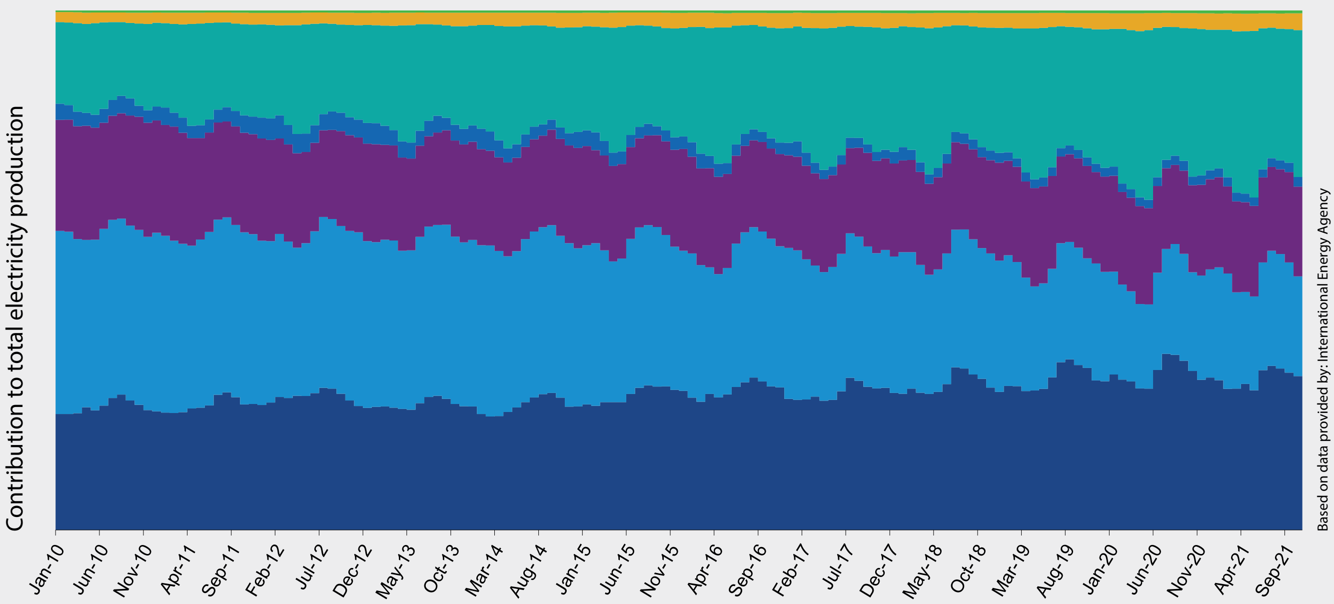
Electricity production by renewable energy source – OECD countries



Hydro Wind Solar Geothermal

Figure 2

Electricity production by energy source (all) – OECD countries

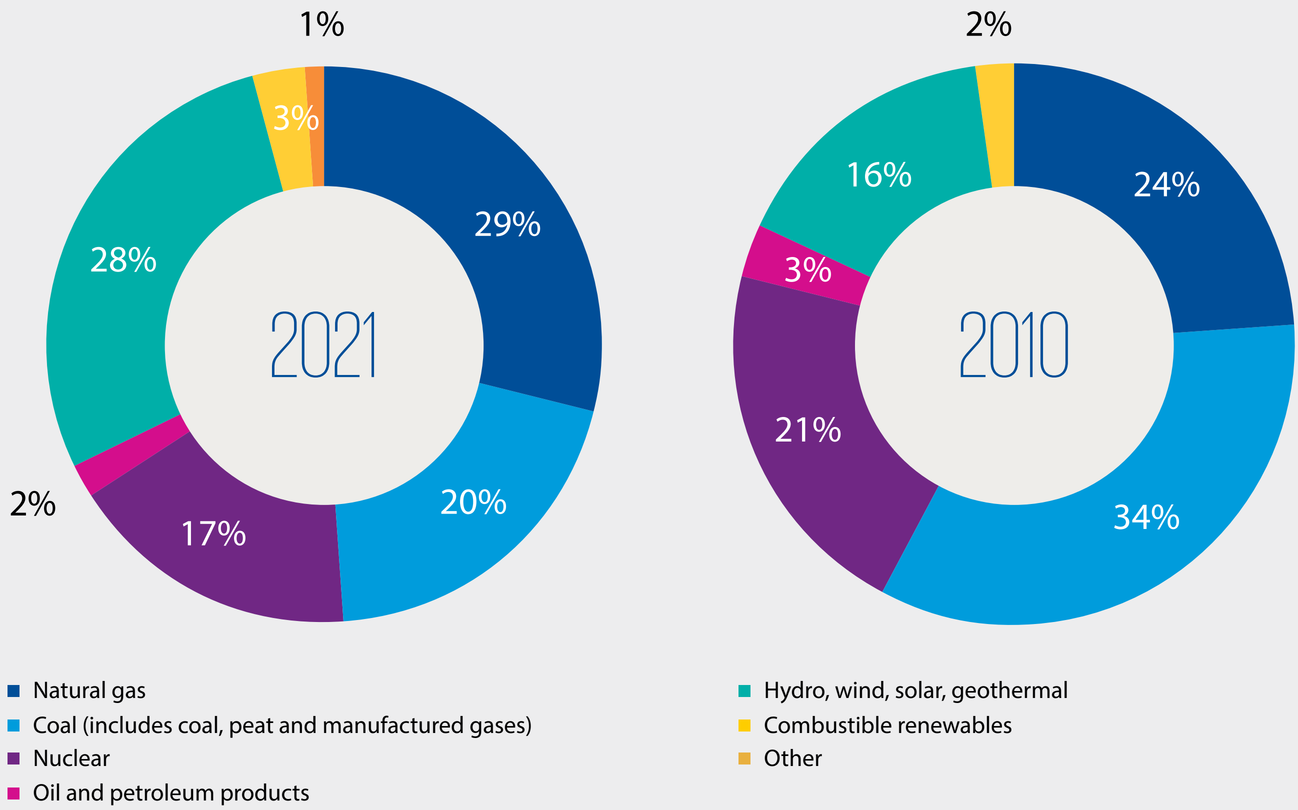


Natural gas
Coal*
Nuclear
Oil and petroleum products
Hydro, wind, solar, geothermal
Combustible renewables
Other

* Coal includes coal, peat and manufactured gases

Figure 2 (cont.)

Average electricity production by energy source (all) – OECD countries



Based on data provided by: International Energy Agency

Recently, there has been an incredible wave of investment and activity spurring the energy transition, which is observed in the growing share of hydro, wind, solar and geothermal sources in global electricity production. As shown in Figure 2, these renewables made up 28% of the 2021 total electricity production on average throughout the year, up from an average contribution of 23% in 2016, and 16% in 2010. This adds up to an impressive 76% increase between 2010 and 2021. The transition is driven by a variety of factors including technological improvements and declining governmental barriers that have for so long hindered the global energy transition. In the following sections we explore in more detail the factors which have spurred this recent activity.

Technological innovation

One of the most significant hurdles hindering the transition to renewable energy has been the economics that fossil fuels, such as coal and natural gas, have been the cheapest way to generate electricity. As shown in Figure 2, the sources of electricity with the highest share are natural gas and coal with a combined 2021 average of 50% of all electricity produced in OECD countries. The reason for this is simply the economic competitiveness of these fossil fuels, measured by the much higher amount of energy yield from their respective input resources. Using power density as an example, a measure of energy produced from the amount of land required to source the inputs and produce the energy, natural gas has an estimated power density of 3,000 w/m2 and coal an estimated 1,000 w/m2 on average (Smil 2016). Comparing this power density to even the hypothetical maximum for the "average" spot on earth, for solar energy of 188 w/m2[1], the picture becomes clear as to why fossil fuels have reigned as the leading source for electricity production in the past.

So, what is changing? Why has the portion of electricity production from renewable sources increased in recent years as shown in Figure 2? Improvements in the

[1] Calculated as the solar constant divided by 4 adjusted for atmospheric absorptions and reflections (1,367 w/m2 ÷ 4) * (1-65%) = 188 w/m2 (Smil 2016)

underlying technology as well as economies of scale leading to lower costs to purchase solar PV cells and wind turbines as well as construct solar PV and wind farms appear to be a key factor. In addition, according to a recent report by the International Renewable Energy Agency ("IRENA"), renewable energy has become the world's cheapest source of electricity in 2020 with an estimated 89% reduction in the price of electricity from new solar PV power plants and a 70% reduction in the price of electricity from new wind farms in the past 10 years driven by improving technology and economies of scale, among other factors. By contrast, coal only saw a 2% reduction in electricity price during this 10-year period (IRENA, 2021). This shift in underlying economics has given renewable energy a significant tailwind in the energy transition.

Governmental forces

In recent years governments around the globe have expanded their efforts towards decarbonization and the energy transition. This is evident in the clear targets set by countries across the world to reduce their carbon footprints and fight against global warming. For example, the Paris Climate Agreement, which entered into force in November 2016, is a legally binding international treaty signed by 192 countries plus the EU and sets long-term goals to respond to climate change. Such targets include a limit on the long-term increase in global temperature to below 2 degrees Celsius, with efforts towards 1.5 degrees, compared to pre-industrial levels. Other important aspects of the Paris Climate Agreement include various frameworks to support countries in their efforts to meet their own goals as well as those of the Paris Climate Agreement. In addition, the agreement puts into place various reporting requirements to track progress. These expanded efforts to fight climate change are evidence of the shift in the global awareness and interest in how we satisfy our energy needs. The agreements reached with the Paris Climate Agreement have been further reinforced and extended with the recent COP26 summit that took place in Glasgow in November 2021, in light of the seriousness of recent natural disasters driven by climate change.

Increased investment in renewable energy

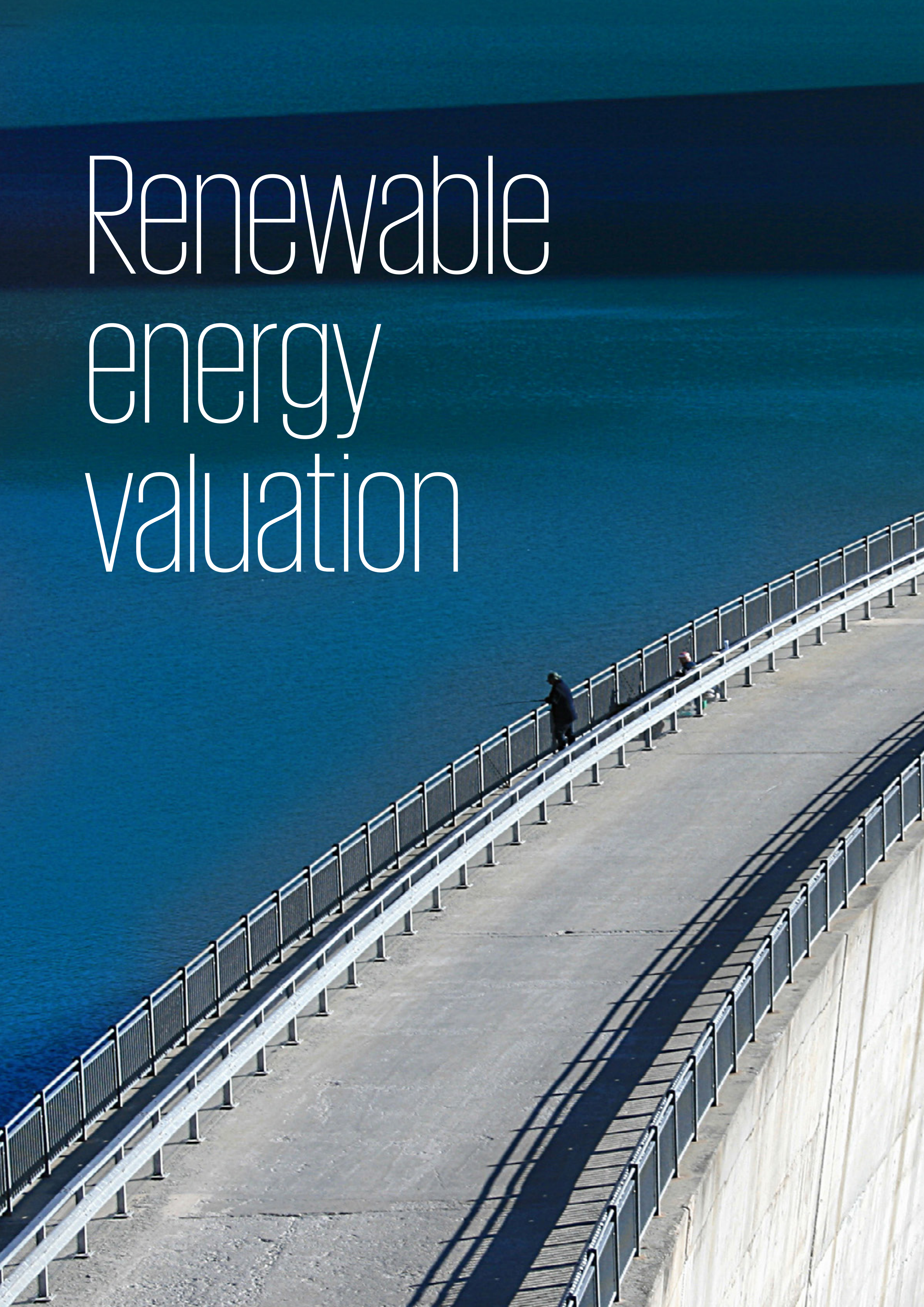
These forces are driving forward a nascent wave of investment and activity in the renewable energy sector. As shown in Figure 3, this is evident in the 45% increase in net capacity additions of renewable energy sources globally between 2019 and 2020, further highlighting the 23% increase in average contribution to total electricity production from 2016 to 2021 from renewable sources as mentioned before and shown in Figure 2, which may indicate this increase will continue into the future.

Figure 3

Net renewable energy capacity addition growth 2012 to 2020 – Global

Based on data provided by: International Energy Agency

Renewable energy valuation



Valuation of renewable energy assets are required at different points in time throughout the investment lifecycle. Oftentimes, a valuation is required prior to investment, be it a greenfield investment, an M&A transaction, or a repowering investment. In these circumstances, the valuation model will yield a net present value, which can be used as a starting point in the negotiation process, or an internal rate of return can be derived assuming a certain initial investment. Valuation of renewable energy assets may be required also after the initial investment, for financial reporting or tax purposes as well as for post-acquisition assessments.

Valuation methodologies overview

Valuation analysts rely on three generally accepted valuation approaches to estimate the value of an asset: the Income Approach, the Market Approach and the Cost Approach.

The Income Approach, which determines value based on projected future economic benefits to the asset's owner(s), is commonly used when the valuation practitioner is able to reasonably project the asset's performance over time, making assumptions regarding growth, margins and further investments to support the planned growth, among others. It is often the preferred valuation approach when quality data is available due to its greater transparency.

The Market Approach, which determines value based on the observed purchases of similar assets, most often in the form of quoted prices of similar publicly traded companies or transactions of private companies, is strongest when there is a reasonable number of recent, comparable transactions available upon which the value of the asset or business can be implied.

The Cost Approach, which determines value based on estimates of the cost to reproduce or replace an asset or business, is strongest when such costs can be reasonably estimated, and when the performance of an asset or business is not expected to increase over time, such as increased future profitability. If the performance of the asset or business fluctuates over time, it is likely the Income Approach would be a better alternative to the Cost Approach.

As will be discussed later in this newsletter, renewable energy assets are subject to various market forces which impact performance and limit usefulness of certain traditional valuation approaches. For example, the usefulness of the Market Approach may be limited by the dissimilarity in the risk profiles unique to each asset or renewable energy project, which may be difficult to reflect under this approach. For this reason, the Market Approach is generally not relied upon by valuation analysts when valuing renewable energy assets. The Cost Approach tends to be omitted in the valuation of income-producing assets such as renewable energy assets.

Income approach: The discounted cash flow method in renewable energy valuation

As the benefits to the owner(s) can generally be reliably estimated, the most often used method to estimate the value of a renewable energy project is the discounted cash flow ("DCF") method, a widely used method under the Income Approach. Through the DCF method, complexities such as reflecting Power Purchase Agreements ("PPA"), Feed-in-Tariffs ("FiT") and merchant price exposure, can be reflected in detail throughout the life of the project. This allows for sharpened consideration of both the risks and rewards relevant for investors and owners of the asset.

Key factors in projecting revenue: Volume and price

For renewable assets, the top line is the product of volume, i.e., the quantity of electricity produced (expressed in megawatt hours (MWh) in a given year by the asset, and price, i.e., the price at which the electricity can be sold (EUR/MWh).

Volume

The volume of electricity produced is a function of the following input:

- Capacity: Generally expressed in megawatts (MW), capacity is a measure of power which depends on the quantity of modules in a solar PV farm or the quantity of wind turbines in a wind farm, for example. While the exact capacity of a single solar PV module depends on many factors, with current technology you would generally expect between 3,000 and 5,000 solar modules to have a capacity of 1 MW
- Specific yield: Generally expressed in MWh/MW, the specific yield is a measure of the yield of a given asset to generate power (MWh) out of its installed capacity (MW). It is generally based on historical statistical models which consider meteorologic aspects in the specific geographic area (irradiance, wind hours) as well as technical aspects (degradation of modules)

Price

Likely one of the most difficult areas of renewable energy valuation, estimation of the future prices at which the electricity produced by the renewable energy asset is likely to be sold is one of the most decisive inputs to determine the revenue projections over the life of the asset. Thanks to various mechanisms which exist in the energy market, investors in renewable energy assets can minimize this challenge by taking measures to stabilize revenue projections via PPAs and reflecting any available FiTs in their valuations.

Feed-in-Tariffs

As discussed previously in this Quarterly Brief, over the past decades the cost of producing electricity from renewable sources has been much higher than today, leaving renewable energy at a relative economic disadvantage compared to fossil fuel sources. Acknowledging this, various governments around the globe implemented FiT mechanisms to incentivize investment into renewable energies and temporarily eliminate this relative economic disadvantage. For example, in Germany – the global leader in harnessing solar radiation for electricity – most solar PV cells are not in large-scale solar farms but rather installed by homeowners and businesses on their rooftops. Many took this step in response to Germany's Renewable Energy Act of 2000, which introduced guarantees in electricity prices for 20 years (Smil 2016).

The introduction of these incentive mechanisms, coupled with improvement of the underlying technologies for renewable energy, created a self-reinforcing cycle of demand, which in turn further lowered the costs related to renewable energy. As mentioned previously, over the past decades the costs to construct renewable assets have decreased significantly and today solar and wind are the cheapest forms of electricity production as evidenced by the 89% and 70% decline in the price of electricity from new solar PV farms and wind farms, respectively (IRENA, 2021).

Power Purchase Agreements

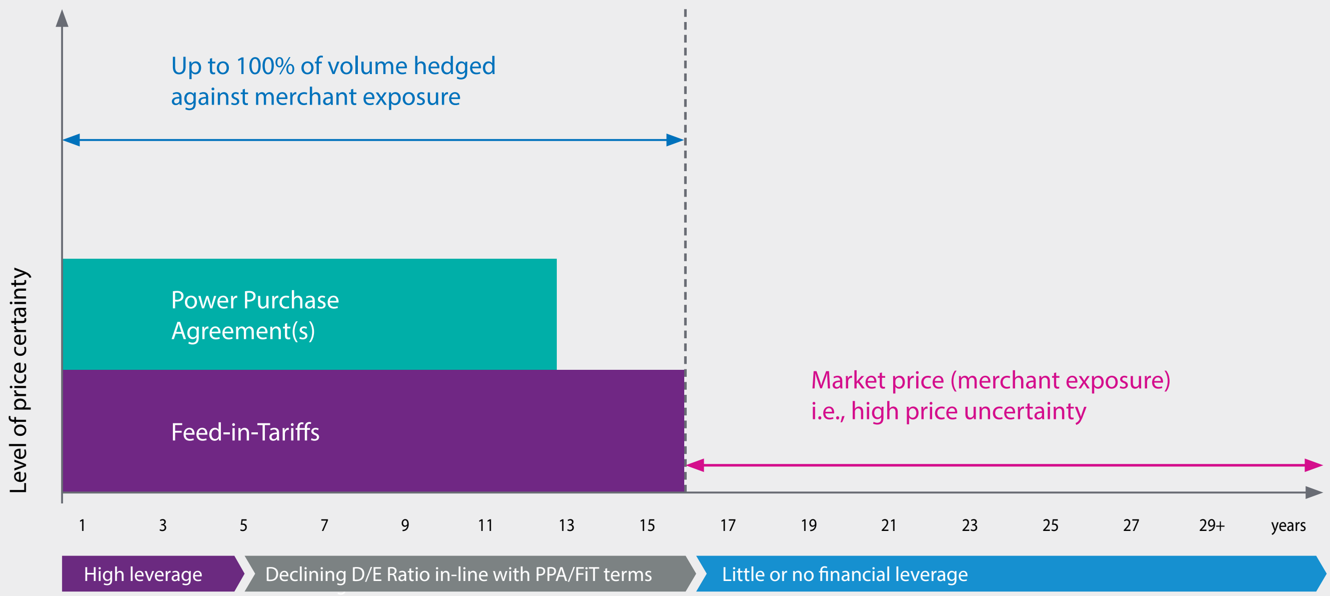
Another key mechanism available to investors to stabilize cash flows and, thus, reduce risk in the fluctuation of price of electricity are Power Purchase Agreements. PPAs are simply unsubsidized contracts between energy producers and private buyers, such as companies that need electricity for their operations. Buyers, also called "offtakers" in this context, commit to buying energy at a fixed price from the energy producers over a certain period, often between five and 15 years, regardless of the prevailing market price. Generally, a certain volume is agreed upon to be supplied/ purchased which may or may not be 100% of the energy producer's output. This plays a critical role in the project's risk profile and impacts the investment decision-making process as well as the level of leverage which may be obtainable for the project.

Merchant price exposure

As shown in Figure 4, upon expiration of the PPAs as well as any applicable FiTs, the project enters a period of merchant price exposure, i.e., direct exposure to the

Figure 4

Stages of risk for renewable projects



Source: KPMG

fluctuations of the prevailing market price of electricity in the electricity spot market. At this point in the lifecycle, the project is in its highest level of uncertainty regarding future risk and return, which presents difficult valuation challenges. In practice, the estimation of the future prices during this period of elevated uncertainty is typically accomplished by referring to studies from specialized third-party data providers who publish what are known as "power curves". These power curves express their predictions on future energy prices and are developed using proprietary methodologies and complex econometric models. Additionally, power curves may also be developed in-house by major players in the energy sector who have experience in estimating and understanding the determinants of energy prices such as supply and demand factors or inflation, among many other influences which are outside of the scope of the newsletter. In addition, investors and valuation practitioners may consider a bundle of such power curves from a variety of third-party sources to create a consensus regarding the direction of merchant prices, especially considering such curves may be prepared on a region-specific basis.

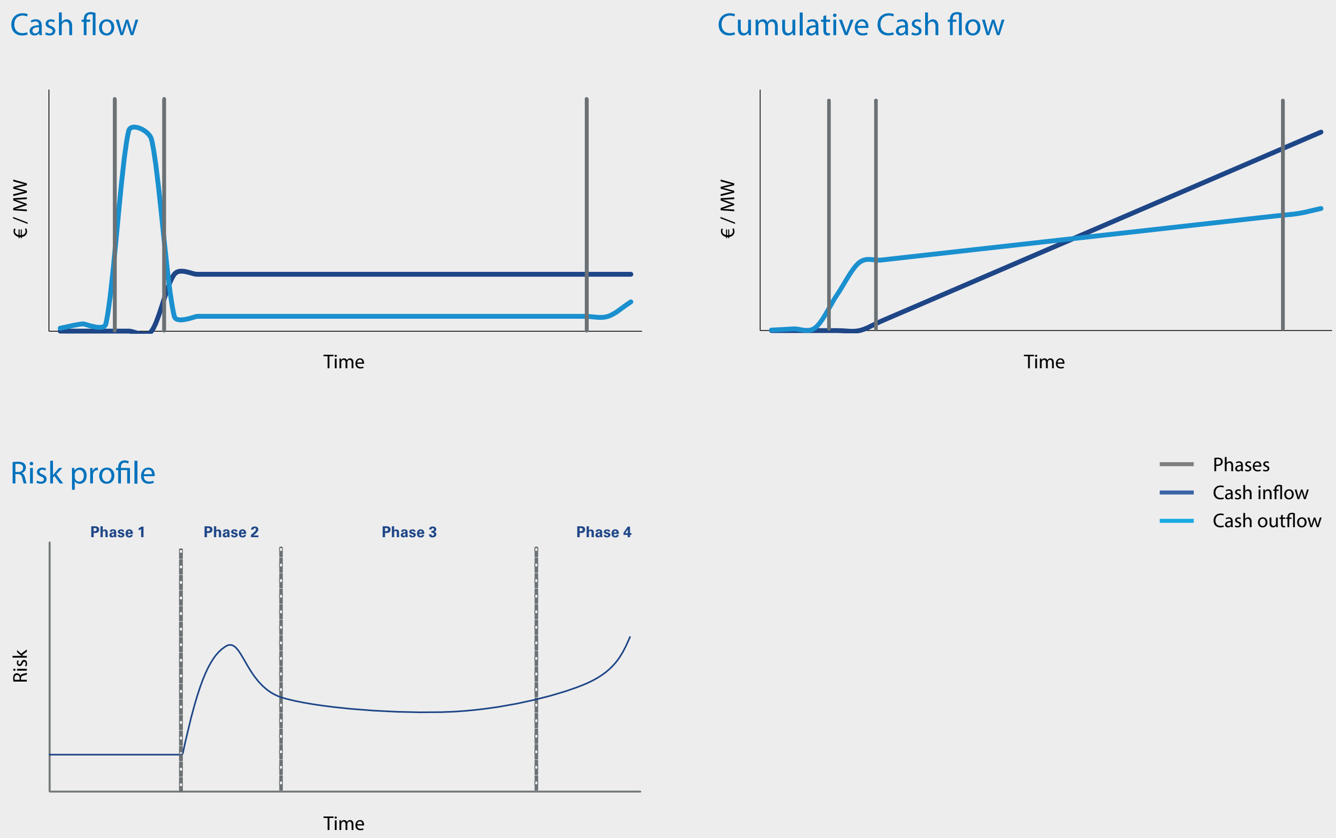
Discount rates

A discount rate must be estimated that reflects the risk in achieving the cash flow projections. As renewable energy projects have some quite unique characteristics, care must be taken in the estimation of a risk-equivalent discount rate for those projects.

One of these unique characteristics is the lack of a terminal period as renewable energy projects are finite lived i.e., they will eventually be decommissioned. The cash flows are projected out until the end of the remaining useful life of the project, generally in line with the technological life, often 20 to 30 years. The finite lived nature of renewable energy projects determines the investment time horizon, which in turn impacts inputs such as the risk-free rate.

Business risk of renewable assets differs significantly over the different phases of the renewable asset lifecycle as shown in Figure 5.

Figure 5



During phase 1, business risk is relatively low since all the preparation work such as feasibility studies, government and regulatory approval, land lease, negotiating PPAs, etc. does not result in material cash outflows. Projects during this phase are generally referred to as "Pipeline Projects."

Once preparation work is concluded, construction kicks off phase 2. The project experiences its highest risk in this phase due to the relatively high cash outflows paired with the uncertainty with respect to delays and unexpected additional construction costs. During this phase, business risk is comparable to any infrastructure construction project. Projects in this phase are generally referred to as "Assets Under Construction".

Upon completion, the Commercial Operation Date ("COD") marks the beginning of phase 3. The project is put into operation, electricity is produced and sold at electricity prices often contractually secured via FiTs, PPAs or both. During this period of limited or no merchant price exposure, cash flows have a relatively low volatility and high predictability, thus the business risk is very low. The risk in this phase is often comparable to utility companies or network operators due to the similar subsidized and/or regulated nature of their returns.

Finally, during phase 4, the electricity is sold at prevailing spot prices at full merchant price exposure unless new PPAs can be contracted. Projects in phases 3 and 4 are generally referred to as "Operational Assets".

At the beginning of a renewable energy project, as is the case for investments in other infrastructure assets, project finance plays a key role, with an initial high leverage of up to 80% debt of total funding. Once the asset is selling electricity, the operating cash flows are utilized to pay down the debt, leading towards a shifting capital structure from majority debt financing at the beginning to majority equity financing in the latter years. The evolution in capital structure is often engineered to take place at the end of phase 3, aligning the merchant price exposure with lower or zero levels of leverage.

Due to the changing nature of the risk profile of renewable energy assets over their lifecycles, and the materially changing financing structure, valuation practitioners often apply period-specific discount rates. This approach is more sophisticated from a technical perspective but leads to more transparent and realistic valuation conclusions.

An expert view on the complexity of renewable energy valuation

KPMG Valuation Services regularly assists companies of all sizes with complex issues related to renewable energy valuation. Our valuation specialists will be happy to discuss your situation and share our views and expertise to help you navigate valuation issues in these transformative times.

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