CHAPTER 17

Financing of Energy Investment

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The future landscape of Energy projects is likely to be a mix of fossil fuel and renewable Energy investments, some completed years ago and still operating or in need of a technical upgrade, and some others that are currently under development or at their commissioning phase. Even in a conservative scenario (moderate Energy consumption growth combined with improvements in efficiency), the investment required in the very near future to sustain the development of world's economies is still enormous.

In that context, the financing of any Energy investment poses at least three different challenges.

The first is the amount of bank loans available to develop or refinance Energy projects since the 2008 financial crisis. The subsequent credit market contraction directly impacted projects meant to be closed in 2009 and 2010 but also projects initially completed in the mid1990s and reaching their refinancing stage in 2008–2010. Indirectly, it also reshaped the financing landscape for all Energy projects in the 2010s, forcing project sponsors to seek for new sources of monies and provide additional reassurance to investors, who in turn have responded with innovative financial instruments and structuring packages.

The second is the competition to attract funds. In the context of an investment gap, investors have now, more than ever, a wide choice when it comes to where and how they may allocate their funds. The profitability of Energy projects is being highly scrutinised with particular attention paid to the volatility of cash flows and the cost of financing. Investors, notably those with previous experience in the Energy sector, will also thoroughly conduct due diligence covering the non-financial benefits of a potential investment, such as a stepping

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into a new country or sub-market, establishing a joint-venture with a desirable partner, or building or reshaping their asset portfolio.

Finally, when it comes to financing Energy projects, there is little room for replication. A small-scale solar project in a developing country faces different challenges, carries different risks and attracts different potential investors than a liquefied natural gas (LNG) plant in the USA. With lower-income countries needing more Energy to sustain the development of their economy and the necessary shift towards renewable sources, there cannot be a "one fits all" financing structure.

With these challenges in mind, this chapter describes and discusses the main steps in the financing of any Energy project, then focuses on the respective characteristics of projects depending on the Energy source at stake.

The first step in financing an Energy project is to assess the size and the nature of the funds needed to sustain its development (Sect. 1). The structuring itself requires to identify the most efficient financial model and to source funds from relevant investors (Sect. 2). Although various mechanisms and policies have encouraged investment in all segments of the renewable Energy sector, there is still a huge diversity of financing opportunities among individual renewable Energy sources (Sect. 3). Meanwhile, the well-established financing models for oil and gas projects, which still represent a significant share of the Energy mix, have been able to adapt and innovate (Sect. 4).

1 Identifying the Volume and the Nature of the Funds Needed

1.1 Project Viability Analysis

The analysis of a project's financial viability involves the calculation of the Internal Return Rate (IRR) that investors can reasonably expect to remunerate the risk/return, the opportunity cost plus their own funding cost to mobilise their money into that project. The project IRR depends on the project's costs, its revenues and the risks attached to both. Financing an Energy project therefore starts with a thorough risk assessment in addition to its economics projections.

1.1.1 Revenues

Depending on the Energy sector and technology, investors might gain various levels of comfort on the project's future revenues. In the upstream oil and gas sector there is generally no specific government regulated price or support, and the project revenues will mostly depend on the production profile of the asset and the price of the extracted commodities. If the production output is sold to a specific buyer, such as a refiner or a long-term purchaser of LNG, then investors will expect the price and volume of production sold to follow the conditions set forth in a Sales and Purchase Agreement (SPA) recording the undertakings of both parties. When the production is exported to a global commodity market, it is sold at the international market price (including on futures markets—which may be used to hedge the price volatility) taking into account the transportation cost. While an international market price has always existed for oil, LNG has historically been a point-to-point, producer-to-buyer market and there was no single international price *per se*. But, as the LNG markets gain in maturity and availability both in producer and receiver facilities globally, spot LNG and forward gas markets develop and progressively replace long-term, fixed- or indexed-price SPAs.

For renewable power generation, governmental support through various mechanisms has constantly underpinned the development of the sector and its attractiveness for investors. Feed-In-Tariff (FIT) policy, a long-term (15 to 20 year on average) contract setting a fixed price for the generated electricity and a guaranteed grid connection, is the most widely implemented renewable Energy policy instrument, adopted by more than 100 jurisdictions at the national, state or provincial levels in 2018 (REN21 2019). Some FIT policies even adjust the tariff depending on the phase of the projects. Coupled with the possibility for developers to enter a Power Purchase Agreement (PPA) this scheme offers potential investors a high level of assurance on the future revenues stream, provided the governmental support and the FIT are preserved for the duration (or at least for the payback time) of the project. A PPA requires the power producer to supply to the purchaser (the "off-taker", usually a state-owned electricity utility) a certain amount of power at a specified price throughout the life of the agreement, in exchange of which the purchaser accepts to pay a capacity price, linked to the availability of the producing plant, in addition to the Energy price per KWh. A PPA reduces cash flow uncertainty, making the investment similar to an annuity bond which is the type of security and return that institutional investors typically look for. A rating can be assigned to this debt, taking into account the risk profile of the project, including the creditworthiness of the off-taker.

In developing countries where the off-taker is often a national utility (which may be subject to financial stress), the rating of the project can be improved by several credit enhancement or insurance mechanisms provided by international financial institutions or private insurers. Investors can also benefit from tax credit mechanisms where a tax credit originated by their investment can be used to offset tax liabilities in other segments of their businesses. This is called 'Tax Equity' and it has been used to encourage investment into renewable Energy in the USA. Many substantial wind and/or solar projects have been developed thanks to the Production Tax Credit for wind and the Investment Tax Credit for Solar.

1.1.2 Costs

Financing a project in a high-risk, capital-intensive industry can expose the investors to major cost uncertainties, in particular when unforeseen events or cost- or time- overruns impact the project and jeopardise its financial viability, or because the cost of alleviating these risks negatively impacts the project economics. Depending on the sector, the size of the project, its location, and the stage at which the financing is required, the risk profile is obviously different.

However, most Energy projects carry the same three types of risks. First is the legal environment: Are there rights allowing the project to be built and to operate in place? Are there any sovereign guarantees? What are the relationships with the host government? The TNK-BP project is a "worst case" example of a political and country risk in the Energy sector. In 2003, UK-based oil major BP entered into a joint-venture agreement with AAR, a Russian consortium, establishing a new structure, TNK-BP, which at the time accounted for about one quarter of BP's then global oil production. Although it proved to be a rather successful investment, at the end, mainly because of the rise in Energy prices, BP had to face severe setbacks such as back-tax claims adding up to US$936mn and various expropriation attempts.

Secondly, Energy projects carry environmental risks, each type of project to a different extent. While this seems obvious for nuclear plants and oil exploration and production, it is also the case, for instance, for wind farms especially offshore as regards the decommissioning phase.

Last but not least, the project's operational risks *stricto sensu*, which includes construction risk and operation risk, is probably the type of risks that experienced industrial sponsors and developers can more easily anticipate and hence mitigate.

Costs incurred at the construction phase and the operation and maintenance (O & M) phase are allocated differently depending on whether the Energy technology requires the purchase, import and transport of fuel (Frankfurt School 2018). While circa 85% to 90% of total project costs of solar, wind and hydropower projects in developed countries are consumed by equipment and construction costs, that percentage drops to circa 65% for coal projects and down to circa 30% for gas projects (CPI 2014).

Capital costs for renewable Energy projects have been decreasing over the past few years (Swiss Re/BNEF 2013) and projects which would have not been viable in the past can now deliver a return deemed attractive by investors (Frankfurt School 2018). Thanks to a combination of improvements in manufacturing processes (notably due to new entrants often pushing prices down), economies of scale and technological innovations, wind turbine prices have decreased by about 30% between 2013 and 2016 (World Economic Forum 2017). As a result, onshore wind has now become one the cheapest sources of electricity in many countries. Solar photovoltaic (PV) modules costs have also been reduced dramatically, by more than 75% between 2009 and 2016 (IRENA 2016). These trends are reflected in the strong reduction of renewable energies' Levelized Cost of Energy (LCOE), an economic assessment of all the costs of an Energy generating system over its lifetime, including initial capital investment, O & M costs, cost of fuel and cost of financing (the latter is discussed further in the next section).

Unforeseen events can incur exceptional costs, even after the construction and completion stage. One of the most common cases is a substantial damage to the producing asset, which is why investors often require that developers buy an insurance cover for operational risk. Other exceptional events include delay and overruns, especially in mega projects such as oil refineries, nuclear or LNG plants. To mitigate that risk, potential investors will be willing to see that selected contractors and suppliers have a strong track record in that specific Energy segment. Two contracts will focus the attention of the fund providers: the Front End Engineering Design (FEED) contract, identifying the technical requirements and a rough cost estimate for the project, and the Engineering, Procurement, Construction (EPC) contract for the procurement of equipment and material and the construction and commissioning of a fully functioning facility.

1.2 *The Nature and the Cost of Funds*

1.2.1 *Financing Instruments*

The three main instruments which can be used to fund an Energy project are equity, debt and hybrid instruments. For each of these, the risk level and hence the expected return vary as described in the figure below (Fig. 17.1). Bank debt ranks ahead of equity, which means that when a project is no longer financially viable, invested equity is used to cover losses, and monies recovered are paid to the bank first. For the higher level of risk they take, equity investors consequently expect a higher IRR, ranking typically between 15% for infrastructure funds to 30–35% for Private Equity funds (see Section 2).

Hybrid instruments combine characteristics of equity and debt. They offer more flexibility to investors and can be an entry point for those not familiar with Energy projects, or wishing to limit their contribution to a very specific stage of the project. One hybrid instrument, mezzanine finance, has been

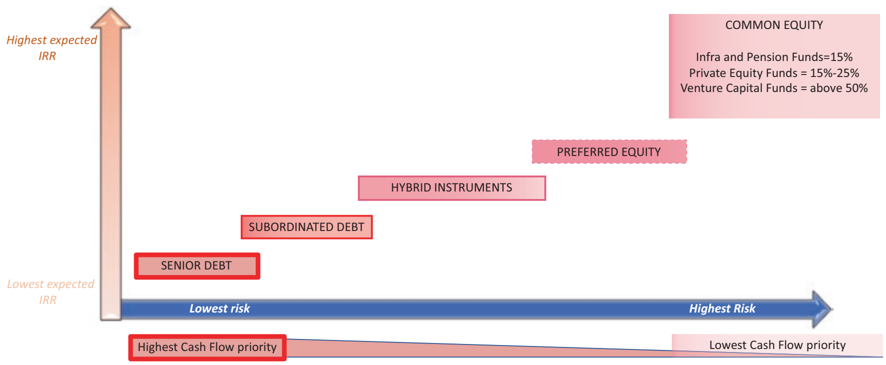

Fig. 17.1 Risk and return of different financing instruments. (Source: Authors' elaboration)

increasingly used in the financing of Energy projects over the last two decades, especially for projects where most of the costs are incurred at the construction phase. Mezzanine is more expensive than traditional bank loans, but cheaper than equity, and does not take control away from project sponsors, as it is not dilutive. Another argument in favour of mezzanine is that it puts less pressure on the project's cash flows, as regular payments of a mezzanine loan are made after those of a senior debt.

Mezzanine offers a higher return and a longer tenor than senior debt. Energy project sponsors may typically seek mezzanine loan if equity is perceived as too risky (country risk) or too expensive, and/or if the amount of senior bank debt available is insufficient.

The distinction between equity and debt is blurred by definition with a hybrid instrument, but it can also be so in case equity is funded by debt. When sponsors such as large oil and gas companies or state-owned utility companies finance their equity contribution, they might need to borrow funds from one or several financial institutions, the latter making the loans against the creditworthiness of the sponsor.

1.2.2 Cost of Financing

One of the primary criteria for equity and debt investors is the minimum rate of return that they expect from the project into which they would channel their money. It is measured through the Weighted Average Cost of Capital (WACC), which reflects the overall cost of financing, taking into account the respective weight of equity and debt in the financing structure. Any scheme or instrument that lowers the cost of additional equity or gives investors a higher level of reassurance on their future revenue stream, such as FIT policies or power purchase agreements, lowers the cost of capital. Conversely, the end of previously existing subsidies or the lack of government support mechanisms means that banks will require to see a higher share of equity in the project. Notably for these reasons, the cost of capital for oil and gas companies is traditionally higher than for power companies, with a higher cost of equity and a higher share of equity in the capital structure (IEA 2019).

The risk of increased cost of capital due to construction cost overrun can be anticipated and mitigated with the introduction of an EPC contract or a turnkey contract in the financing package. Both are designed to satisfy the lenders' requirement for bankability and to provide a single point of responsibility (one single contractor coordinates other subcontractors and service providers), a fixed contract price and a fixed completion date. The fact that the contractor, and not the owners, bears most of the construction risk in the end is the sort of guarantee that investors now almost systematically require.

The cost of capital also reflects the perception of political and economic risk, which is why it can vary quite dramatically between projects. For solar PV projects in Europe for example, WACC in Germany is on average 4%, while it can reach up to double digit figures in Greece (DiaCore 2016). In many developing countries, the cost of financing can be even higher, as debt is structurally more expensive. This is due to the limited supply of capital available for long-term investment and also to currency exchange risk, that is, a potential devaluation of the currency in which the investment was initially made (CPI 2014). Smaller projects are even less attractive for private investors than large-scale projects, as in addition to expensive debt there is often a lack of equity sponsors (which in turn increases the need for debt financing) and potential grid connection issues. This is why greenfield Energy projects in developing countries rely heavily on public finance institutions, such as multilateral and bilateral agencies acting as facilitators for other investors.

Since the 2008 financial crisis and the subsequent coming into force of Basel III regulations, commercial banks are extremely reluctant to offer debt for longer than seven to eight years (compared with the 15-year loans available before the crisis). Project developers having to refinance the project before it is completed now turn more easily to project bonds, an instrument which was traditionally used only to refinance completed (hence less risky) projects but is now increasingly popular in the earlier stages of the investment. When the capacity of the bank market contracted in 2008, interest in the project bond market was reignited, and 2009 saw a string of project bond issuances, notably for LNG facilities or gas pipelines, competing with comparable bank loans (Latham and Watkins 2009). Arranging project bonds to finance projects in their construction phase requires various tools of risk mitigation such as fixed-price turnkey contracts—but investors are now familiar with these.

One relatively new form of bond financing is "Green Bonds" which can finance projects tackling climate change or encouraging Energy transition and Energy efficiency. More attractive than comparable taxable bonds as they come with tax incentives, these bonds are often used as a refinancing tool once the construction has been completed. Issuers of Green Bonds include development banks (such as the World Bank), commercial banks, public sector agencies and corporations.

2 Structuring the Financing of an Energy Project

2.1 Financing Models Used for Energy Projects

2.1.1 "Corporate Finance" and "Project Finance"

Although there is a huge variety of financing structures in the Energy sector, all projects fall into two large categories, depending on which investor or stakeholder is eventually liable for the project's upfront costs. In an "on-balance sheet" financing, the sponsor, either a large Energy company or the host government, uses its own balance sheet to fund the project. The choice of "Corporate Finance" is without the prejudice to the origin of the funds, as the project sponsor might need itself to borrow funds to finance an Energy investment. In the case of host government financing, the financial contribution is made to the off-taker which then uses the funds to develop the project. Here again, the choice of "on-balance sheet" financing does not dictate the form of the contribution, which can be a loan or equity.

The second type of financing structure is "Project Finance", when a special purpose vehicle (SPV) is created "off-balance sheet" of the developers, with the sole purpose of developing and operating a specific Energy project. The SPV receives equity contribution from its shareholders and borrows funds from commercial banks and other sources. Loans are then secured by all the assets and the commercial rights of the SPV, but only by these assets. It means that if the SPV was not generating enough cash for the service of the debt, the lenders, left with no recourse against the shareholders, would become the owners of the project. Project Financing requires more complex transactions than Corporate Financing and it is usually more expensive, as it incurs transaction costs and costs incurred by potential delays due to the coordination of multiple parties involved. However, it has been and is still widely used in the Energy sector as it gives the option for investors to participate to only a slice of a bigger project, depending on the level of IRR they are seeking. Because of the in-built transaction costs, Project Finance is usually only a viable option for projects large enough to justify these additional costs. Generally speaking, lenders take some reassurance from a larger amount of equity invested by the project sponsors and developers as it reflects their commitment and incentive to see the project through to completion. Over the last two decades, Project Financing has evolved under the increasing scrutiny of rating agencies (which now include off-balance sheet debt in their analysis of the company) and of course under the Basel III regulations. While leverage ratios in the 70% to 80% range were not uncommon, they are now more than often closer to 60% to 70%.

2.1.2 The Choice of the Financing Structure

Most of the segments in the Energy sector see a co-existence of projects funded through non-recourse finance (Project Finance) and projects funded through on-balance sheet finance. Although it is almost impossible to assess how many projects per Energy segment exactly have historically been financed on or off the balance sheets of sponsors, the International Energy Agency has gathered data on newly developed projects. In 2018, more than 80% of power investments were financed on the balance sheets of utilities, independent power producers and consumers (IEA 2019).

The nuclear sector has always been an exception in the Energy industry, as all nuclear plants are financed through Corporate Finance. The developer, usually a large utility (sometimes partnering with other utilities) raises financing from its own resources, and loans are taken against all its existing assets. Given the specificities of the asset, Project Financing is not an option for lenders, as in a scenario of no repayment of the debt (probably resulting from an incomplete construction), they would be left indeed with de facto little recourse or even no recourse at all (NEA 2009).

Generally speaking, if the Energy project value is less than US$30–40 m, Project Financing is probably too costly a route. A developer with a reasonably

Table 17.1 Characteristics of Corporate Finance and Project Finance

	Corporate financing "On-Balance Sheet"	*Project Financing "Off-Balance Sheet"*
Specificity	• None compared to other Corporate transactions	• Creating of a SPV for the sole purpose of financing the development of an Energy Project
Recourse	• Resource against the Sponsors' Balance Sheets • Use of Corporate debt capacity	• Resource is limited to the Project's (SPV) Balance Sheet • No claim against the Sponsors' Balance Sheet
Debt service	• On Corporate Balance Sheets	• On Cash Flows generated by the Project
Debt maturity	• Repayment periods are usually shorter than in Project Finance	• Longer repayment periods can be agreed
Gearing	• Lower gearing is possible	• High gearing level
Complexity	• Low to medium—similar to other Corporate transactions	• High coordination of different external teams
Natural candidates	• Companies with very strong Balance Sheets (large-scale utilities) • Project with limited or no recourse (Nuclear Projects) • Small Companies (transaction costs of Project Finance unaffordable)	• Projects too big compared to the Sponsors' Balance Sheets • Projects in high-risk countries • JV with partners perceived as "weaker"

Source: Authors' elaboration

strong balance sheet is likely to consider borrowing some funds through corporate finance in the first instance, unless the project, because of its risk profile, can be managed more safely through a SPV (Table 17.1).

2.2 Investors in Energy Projects

Most Energy projects, especially the large-scale ones, are financed thanks to the contribution of several types of equity providers and debt providers.

2.2.1 Debt Lenders

Commercial banks are traditionally the main source of debt for Energy corporations. According to IEA (2019), debt represents up to half of the capital structure of top listed Energy companies (25% for oil and gas and 50% for power companies). Commercial banks also traditionally finance around 70% of Energy SPVs, de facto reducing the need for a more costly equity financing. In the immediate aftermath of the 2008 financial crisis, the banks' need to reduce their own leverage and exposure to illiquid situations created a relative lack of finance for Energy projects. Now that risks and costs have significantly decreased for many Energy technologies, commercial banks are more likely again to look favourably at this category of projects. Banks can do so either within a syndicate (a group of up to 20 banks for the largest projects, led by one or several banks acting as “arrangers”), or through a “club deal” for smaller projects (and in this case, which is more widely used since the financial crisis, all banks participate on equal terms). Some commercial banks which used to be focused on their regional markets are now more likely to fund projects internationally. Japanese banks have been funding an increasing number of wind projects in Europe; and Chinese banks’ involvement in Africa, be it in fossil fuel or in renewable Energy projects, is now widespread.

The urgent need to provide access to Energy sources for communities and businesses in developing countries justifies the increasing involvement of public finance actors into the financing of Energy projects. While development finance institutions (DFIs) have traditionally focused on grants and concessional lending to fund projects in countries where there is limited access to private finance, they now act as private finance facilitators by offering a wide range of instruments, funds and guarantees. Their intervention de facto lowers the project’s risk profile and attracts local banks lacking the experience or the balance sheet to lend funds outside a syndication. Multilateral development banks, such as the World Bank, the European Investment Bank (EIB) or the African Development Bank (AfDB) use their own capital to provide funds and risk mitigation instruments. Since 2008, the World Bank and its entities have provided almost US$50bn for Energy projects, either to Government entities or to private companies under the form of loan or equity, offering potential investors a higher level of reassurance. Three World Bank institutions are particularly active in the Energy sector: the International Bank for Reconstruction and Development (IBRD), the Multilateral Investment Guarantee Agency (MIGA) and the International Finance Corporation (IFC). The IFC lends to and makes equity investment in private companies, offers syndicated loans and underwrites securities issues by companies in developing countries. The European Investment Bank, which raises its own resources on capital markets, set up a series of renewable Energy equity funds with private entities, and lends mid-term and long-term funds. At the United Nations level, the Multi-donor trust funds, a pooled financing mechanism, promotes renewable Energy and Energy efficiency in developing countries through small- to medium-sized projects. Alongside development banks, bilateral agencies from developed countries, such as US Aid, Proparco (France) and Saudi Fund, provide highly concessional loans to developing countries.

Export Credit agencies (ECA) also play a significant role in Energy financing especially when it comes to large-scale projects. The initial role of the ECAs was to help project sponsors attract commercial bank debt by providing political risk cover in emerging markets. As the need for alternative sources of finance has increased, notably following the 2008 financial crisis, the products offered by ECAs have evolved and now encompass loan guarantee, export credit insurance and direct lending to the purchaser of the project equipment and goods, more than often on competitive terms. ECAs are now mainstream project investors which can finance a significant portion of mega-large projects, as illustrated by the record direct tied lending of US$2.5bn (10% of the total project costs) by the Korean ECA, K-Exim, to the Barakah nuclear power project in Abu Dhabi in 2016 (Irwin et al. 2019).

2.2.2 Equity Investors

While banks provide the majority of the funding, the project itself is primarily initiated and developed by sponsors and developers, which bear the costs of the earliest phases (such as feasibility studies) on their balance sheet. The project's shareholders can be either the developers themselves (oil and gas companies, power companies) or investment companies such as Private Equity (PE) or Venture Capital (VC) funds, but also host governments through a state-backed utility company or a National Oil Company (NOC).

While both VC and PE funds provide equity to Energy projects, they intervene at different stages of a project's life. VC funds focus on early stage, smaller-sized companies such as Energy efficiency start-ups. PE funds can invest as early as the latest phase of the development of the project, provided there is a proven technology, and throughout the construction phase or manufacturing scale-up. They seek undervalued companies and projects, under-performing listed companies, or companies ready to consider a listing. Energy-focused funds have the ability to work in partnership with an existing management team. They can invest either alongside project sponsors and/or with other co-investing PE funds bringing to the table either a regional expertise or previous experience in the project's specific sub-segment.

Infrastructure funds and institutional investors, such as pension funds or sovereign wealth funds, take a growing interest in long-lived physical assets that would match their long-term, low risk liabilities and offer a bond-type IRR. Institutional investors look favourably at insurance products lowering the project risks, and more generally at projects with substantially reduced construction costs or at their refinancing stage. After a few years of operations, once the Energy project enters a lower risk phase, institutional investors have indeed the opportunity to negotiate more favourable debt terms or enter into a power purchase agreement.

Public markets are both an investment category and a source of funds for Energy projects and Energy assets. They offer a high level of liquidity for investors and different forms of entry points, notably equity shares of publicly listed Energy companies or quoted project funds. Energy companies raise funds through stock markets once they have reached certain milestones, although some markets dedicated to smaller growing companies have been used in the past to finance early stage projects. Once listed, the value of the company and hence its refinancing capacity mostly depend on its share price.

3 Financing Renewable Energy Projects

Despite the undeniable attractiveness of renewable Energy sources over the last couple of decades, some projects are still struggling to close financing. In developed countries and China, where governments have supported the Energy transition, renewable Energy has now become a "mature sector increasingly dominated by big industrial players, utilities, and institutional investors" (Frankfurt School 2018) able to fund Greenfield projects on their balance sheets. In developing countries, though, the situation can be dramatically different.

3.1 Financing Solar Photovoltaic (PV) Projects

Although solar PV generation is still more expensive than onshore wind, it is less risky as it relies on fewer moving parts that can be replaced easily (Swiss Re/BNEF 2013). The financing of a solar project notably depends on its size and location.

For a large project (above US$50 m) based in the USA, equity can represent between 15% of the project funding (high capital cost scenario) to 35% (low capital cost scenario) (Feldman and Schwabe/NREL 2018). Small-scale solar (less than 1 MW) is mainly a mix of residential and commercial rooftop systems, with two main financing options for the host companies going solar. Either the system is rented in return of regular fixed payments, or a classic PPA is entered where the host company pays a pre-determined rate to a third-party investor. Installers are turning away from the leasing model to more conventional debt financing (Frankfurt School 2018), with the option to access solar equipment loans for residential PV systems. One of the biggest markets for small-scale solar developments, the USA see the emergence of innovative financing instruments with Green Bonds now being available to residential solar systems. There are also new investor categories, such as Tax Equity investor syndicates, Canadian independent power producers and regional banks. The US solar market has matured notably thanks to the Investment Tax Credit for Solar, which is the basis for a popular financing structure, the partnership "flip" (see Fig. 17.2). Under this structure, the partnership allocates 99% of tax credits, income and losses to the Tax Equity investor, until it reaches a target yield. Once this yield is reached, there is a "flip" in allocation and the Tax investors' share drops. When this scheme expires in 2023, the US solar market is likely to become more competitive and vendors are likely to react by cutting costs.

In developing countries, structuring the financing of a small-scale solar project is a quite different process. Financing of solar lighting or rooftop solar plants can be made through off-grid Pay-as-you-go (PAYG) scheme, where companies sell home system products for a low down-payment followed by regular small payments made by mobile phone services. The users get to own the systems after less than a year for the most successful schemes (Frankfurt

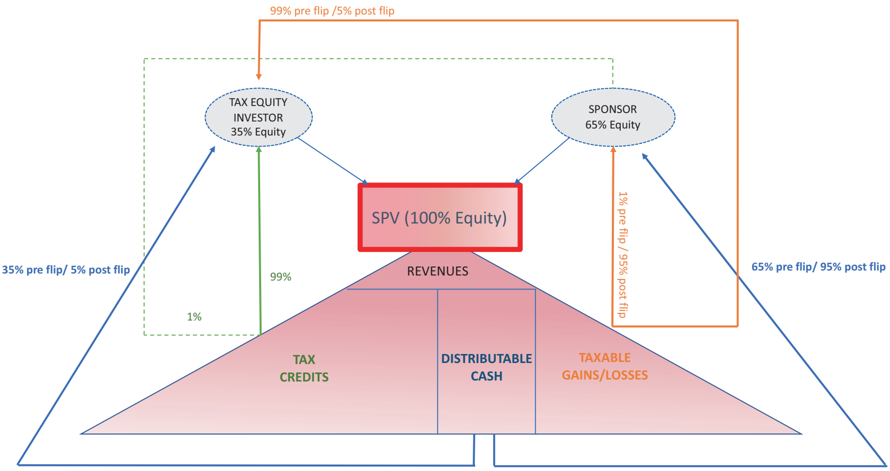

Fig. 17.2 Partnership "flip" structure. (Source: Authors' elaboration [based on Feldman and Schwabe / NREL 2018])

School 2018). These companies themselves are typically funded by VC and PE funds, "impact" investors and multi-donor programmes, and try to replicate the US model of securitising residential solar panels. Off-grid solar systems can be funded by banks, which receive funds from development institutions to reduce the interest rate they will be charging to users.

Some solar projects can be dropped if investors deem the country risk too high for the project economics. If the host State fails to sign power purchase agreements for projects contracted in auctions, or if the tender evaluation process is unclear, investors simply decide not to commit. In South Africa, the repeated refusal of Eskom, the local utility company, to enter into PPAs with renewable Energy developers wiped out the record investment figures from the early 2010s (investments fell to US$100 m in 2017, vs. US$5.6bn in 2012 according to Frankfurt School 2018 report). In India, one of the biggest markets for solar power, some projects were dropped between 2015 and 2018 because their size exposed them to multiple country risks. Some large deals have been secured with robust independent power producers (often teamed up with PE funds and a World Bank participation), but for mid-size projects the environment was significantly different. In some Indian states, repeated cancellations of auctions doubled with the upcoming elections and the subsequent risk of having to cohabit with local public funding pushed private sponsors and commercial banks away.

3.2 Financing Wind Projects

Project Finance has traditionally been the predominant model for onshore wind in Europe, with debt levels of around 70% (Wind Europe 2017). Debt used in Project Finance is traditionally senior debt, and the equity is preferably paid upfront. Yet, the earliest phases of the project (before the permits are obtained) are funded by the developers and the utilities on their own balance sheets. The 2008 financial crisis naturally hit the financing of onshore wind projects as banks became more risk averse, but multilateral lending institutions such as the EIB stepped in. The involvement of multilateral banks made some projects attractive for PE firms and infrastructure funds. Now that onshore wind markets have matured and are undergoing an aggregation phase, attracting large players like institutional investors looking for low risk portfolio companies has become easier.

Offshore wind is still on average more expensive and riskier than onshore. In the UK, contrary to other countries in Northern Europe, power producers traditionally favour on-balance sheet financing for new offshore wind farms (Wind Europe 2017). However, the project size might justify opting for Project Financing. If larger projects carry additional risks, they can also afford transaction costs incurred by off-balance sheet financing. The biggest offshore wind farm in the world since its extension in 2018, the Walney Offshore Wind Farm, was financed through Project Financing, with the backing of many diverse investors (Table 17.2).

3.3 Financing Grid

One of the challenges ahead for financing renewable power generation is grid investment.

While onshore and offshore wind farms can be constructed and operational within 3 to 5 years, grid improvement, extension or interconnection can take much longer. Uncertainty about the evacuation of the power to the national

Table 17.2 Walney Offshore Wind Farm financing

Type of investment	*Organisation*	*Amount*
EQUITY	DONG Energy Group	50.1% majority stake (estimated at GBP 646 million)
	Scottish Southern Energy (SSE)	25.1% minority stake (estimated at GBP 324 million)
	OPW Hold CO UK Ltd. (dedicated investment vehicle for PGGM and Ampère Equity)	24.8% minority stake (estimated at GBP 320 million)
DEBT (relates only to OPW minority stake) 70%	UK Green Investment Bank Royal Bank of Scotland plc Siemens Santander Lloyds Bank	Estimated at GBP 224 million

Source: IRENA (2016)

grid means that onshore wind, despite a generally lower risk profile, cannot always be easily financed.

In the case of Africa's largest wind power project to date, the Lake Turkana Wind Power Farm in Kenya, investors were concerned that the construction of the transmission line would be delayed, as it was funded by Kenya's state-owned utility. After a few years of uncertainty, developers asked the World Bank to provide a partial risk guarantee, but the World Bank declined to do so as long as the Kenyan government would not issue a counter-guarantee. MIGA also declined, uncertain whether the off-taker could buy the electricity. Eventually, the Africa Development Bank issued a partial risk guarantee to ensure the off-taker payments for the first 6 months of power generation.

Grid investment is highly needed in many emerging countries, either as an initial development or as an extension and interconnection in countries where governments already undertook grid programmes in the 1960s. Upper-middle income countries might also require grid investment to enable Energy transition. In Germany, where Energy produced in the north has to be transported to the country's industrial heartlands in the south and west, the estimated capital spending needed to upgrade the grid and distribution networks by 2020 reaches EUR52bn (Zank 2019). This is supported by the transmission system operators, which, although they will claw back the investment through higher tariffs, will need to mobilise external funding beyond their balance sheet.

3.4 Financing Hydropower

With a technical lifespan of 50 to 60 years, high civil work costs due to site specificities of each project and high construction and environmental risks, hydropower plant financing has traditionally relied on public funds. However, years of electricity market deregulation prompted developers to eventually raise funds from private investors. Project Financing was a natural option, especially under Public-Private Partnerships (PPP). As per Fig. 17.3, financing is dependent on the project's future cash flows, set out in a power purchase agreement. Under a PPP, a public administration delegates for a fixed period to a private company the development and the construction of a new hydropower plant. At the end of this period, the facility and its revenue are transferred to the public sector.

A variety of investors and financial instruments contribute to the financing of a new hydropower plant. The host government does not necessarily take an equity share but can provide various forms of guarantees. The developer can issue bonds, and domestic commercial banks, if their balance sheets allow it, can provide a range of loans alongside development banks. The biggest challenge in the financing of hydropower is the gap between the maturity of loans, the debt service obligations and the much longer technical lifespan of the plant. To address this gap, tariffs are usually increased during the first years of operations, making privately funded hydro projects less competitive than other generation sources (and conversely much more competitive once the debt has been

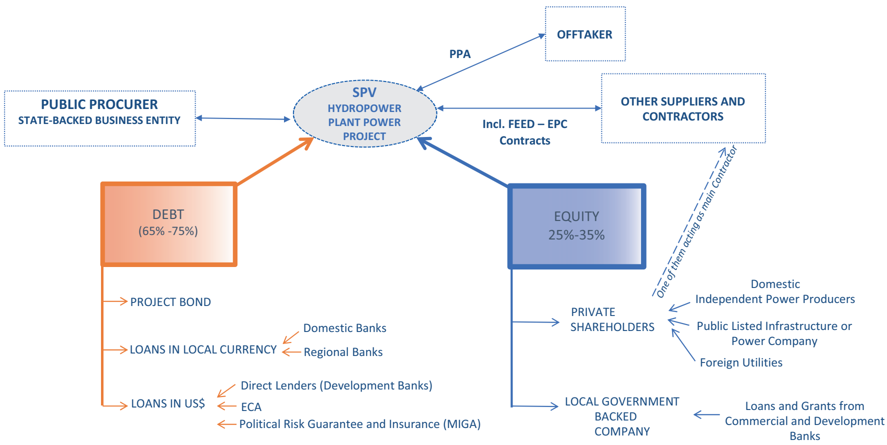

Fig. 17.3 Typical financing of a hydropower plant in a developing country. (Source: Authors' elaboration)

fully serviced). In developing countries, the World Bank's IFC is extremely active to help finance hydropower plants and has developed innovative financing structures to lower the project risk and attract co-investors. IFC has been acting as a developer while offering a political risk coverage through MIGA and has also pooled investments in different renewable Energy sources, creating a platform SPV that will raise Project Finance from IFC and other investors.

Small hydropower projects (under US$100 m of capital investment) are structurally less profitable than large hydro and highly cost sensitive, as the cost of the feasibility studies are almost fixed costs. These small projects can only access non-recourse finance if they are under a feed-in-policy or a power purchase agreement (IFC/Fichtner 2017).

4 Financing Oil and Gas Projects

4.1 *Financing Upstream Oil and Gas Projects*

Upstream oil and gas projects are among the riskiest investments in the Energy industry. The vast majority of the geological surveys do not lead to the appraisal stage. Even when sites potentially containing viable reserves have been identified, the investigations carried out at the appraisal phase might indicate that these reserves are not sufficient to justify the size of the investment required to extract them. These first two stages are entirely funded on the balance sheet of the oil and gas companies, using traditional corporate finance instruments. At the development and the production stages, when the project's cash flows become more predictable, developers can tap into a wider range of funds (Fig. 17.4).

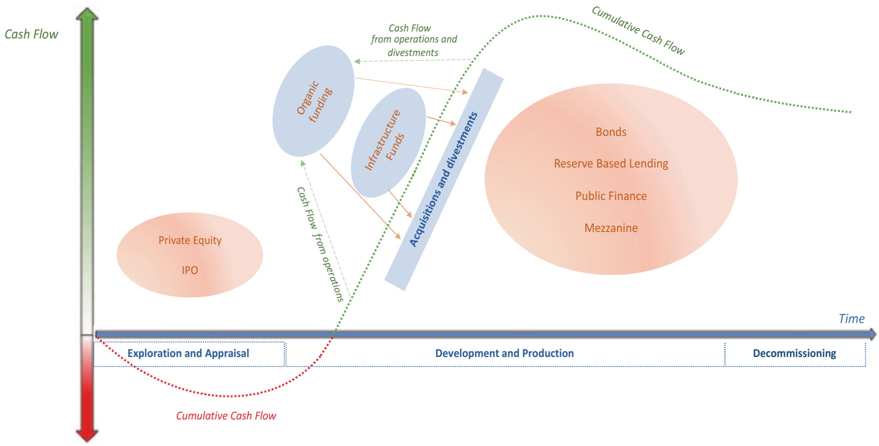

Fig. 17.4 Upstream Oil and Gas—Different funding sources over the life of a project. (Source: Authors' elaboration)

Large Independent Oil Companies (IOC) can finance their pre-producing assets through the reserve-based lending (RBL) model. Commercial banks lend funds on the basis of the net present value of cash flows generated by the underlying reserves. The loan facility is repaid using the proceeds from sales of the asset's output and the amount of the facility is adjusted from time to time during the loan life to reflect changes in the estimated project value. The share price of a listed IOC is driven by the level of production of its producing wells and by its ability to discover, appraise and develop new sites. Careful attention is then paid by investors to the IOC's ability to manage its asset portfolio, as it encapsulates the company's future value.

IOCs looking for funds are regularly in competition with National Oil Companies (NOCs) which increasingly act like private corporations. Both types of companies are looking to tap into local and international debt markets. NOCs from developing countries in Asia and Africa now also use pre-payment transactions to obtain immediate funding in exchange for future oil supply (E & Y 2014).

For upstream projects exposed to a specific country risk, investors will also carefully assess whether and how to partner with the host government. Any change in the country's legal or fiscal environment might impact the value, if not the existence, of the investment. For gas projects, which quite often have a high local content, currency risk should not be underestimated. Private Equity funds considering financing projects in developing countries, especially in Africa, might be concerned about the potential lack of exit, as there is almost no option for a public listing on a local capital market.

Project Finance is mainly used in the upstream sector either by smaller IOCs with insufficient balance sheets or, at the other end of the spectrum, by major oil companies whenever the project risk profile requires it (e.g. country risk).

The use of Project Finance is less popular than in other segments of the oil and gas industry, as the revenues of an upstream project still mostly depend on market commodity prices. Like in other Energy segments, the size of the project has an impact on the availability of funds and the profile of investors. Small, pure-play exploration companies are struggling to get support from commercial banks in the absence of proved reserves and cash flow, and often turn to equity issuance. Private Equity funds specialising in oil and gas are likely to consider undervalued projects showing an evidence of successful operation of similar or adjacent operating wells and led by an experienced management team. Following the 2014 oil crash there was a rebound in interest by PE funds, with an estimated record fundraising of US$39bn by around 50 funds (Senchal 2015). PE funds have also been active in the shale industry, especially in the USA, a natural investment environment for large funds. While Energy majors were able to use their balance sheets to obtain access to shale reserves, small independent players had to look for external financing (new debt and issuance of new equity). As the industry matures, they can now increasingly rely on cash flow generated by their own activities.

4.2 Financing Mid and Downstream Oil and Gas Projects

LNG projects were traditionally ideal candidates for Project Finance, with highly capital-intensive development and construction phases, and creditworthy off-takers (oil and gas companies). Debt would usually not exceed 70% of the total project costs, and equity was provided by sponsors such as large oil and gas companies or sovereign-owned oil and gas entities.

In 1996, the Project Financing of RasGas, a JV between Qatar Petroleum and ExxonMobil, launched a new fully integrated structure, under which the SPV had a stake in every stage of the project (liquefaction, storage and upstream assets). A fully integrated project required the support of extremely robust equity sponsors such as oil and gas state-owned companies and conglomerates, able to assess and mitigate the pure reserve risk, but also allowed higher leverage ratios (Czarniak and Howling 2019).

In the 2000s, LNG financing evolved to a tolling model, where the scope of the SPV is reduced to the liquefaction plant only. Under that structure, the LNG is sold by the upstream companies that tolled through the liquefaction plant. More recently a new financing model has emerged, under which the project company shareholders fund the liquefaction plant through their own equity and subsequently take the LNG into their own portfolios (Fig. 17.5).

The very robust US LNG market has seen an increasingly popular use of alternative sources of financing, as lenders are not willing to extend the part of senior debt in the total project costs. Mezzanine offers sponsors some flexibility to help cover potential cost overruns without any dilution of their equity. ECAs, which have always contributed to the financing of LNG projects due to the need to procure highly specialised equipment and materials, are now very active players in the US LNG export projects, especially K-Exim (Korea), the

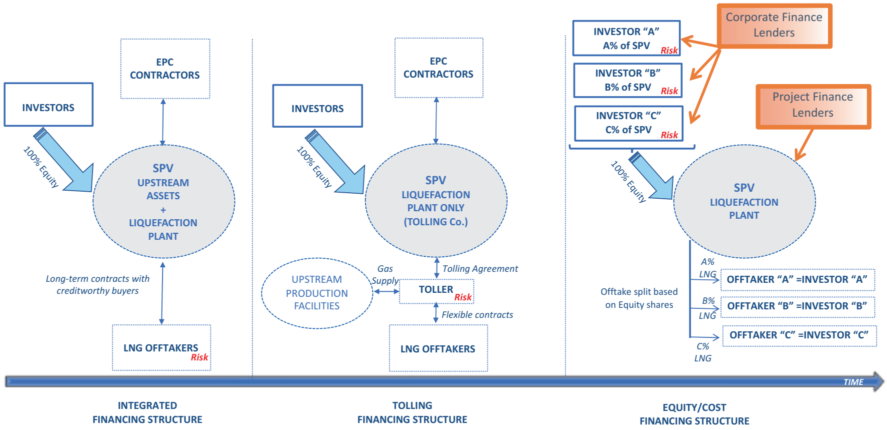

Fig. 17.5 LNG Financing structures—Evolution and innovation. (Source: Authors' elaboration)

Japanese Bank for International Cooperation (JBIC) and US Eximbank (Czarniak and Howling 2019).

A newly built (Greenfield) refinery project has a different risk profile than the upgrade or expansion of an existing asset. A Greenfield project carries pure construction risk coupled with potential country and currency risk, while the upgrade or expansion of a refinery is almost similar to refinancing as it can be mostly funded through traditional loans.

The upgrading of refineries in developing countries, notably to meet European or US standards, can appeal development investors such as World Bank's IFC. The construction of Satorp (Saudi Aramco Total Refining and Petrochemical Company) refinery in Jubail in the early 2010s is a case in point of the variety of financing sources and the complexity of the financial package (Table 17.3). It was the first Project Financing in Saudi Arabia to feature an Islamic bond. Circa 60% of the US$14bn project was financed through debt, a lower level than what was seen before the financial crisis (back in 2004, around 90% of the construction of the Sohar refinery through Project Financing was financed through direct loans of several banks and ECAs). A syndicate of commercial banks agreed to lend US$4.5bn of senior debt at a competitive rate, and several ECAs, together with Saudi Arabia's Public Investment Fund invested another US$4bn. The remaining part of the SPV was financed by the project sponsors, Aramco (62.5% of the SPV) and Total (37.5% of the SPV).

5 Conclusion

As already noted in the introduction of this chapter, the ways to finance Energy projects is not one but many. Depending on the size, the location, the technology, the level of reassurance that investors can get on future revenues, the

Table 17.3 Complexity of a greenfield refinery financing—Satorp refinery in Jubail (based on Petroleum Economist 2010)

Nature of funds	*Source of funds*	*Amount Invested (Estimated in US$ bn)*	*Notes*
Equity <40% of total Project Costs	ARAMCO TOTAL	62.5% of Satorp Equity (US$3.5bn) 37.5% of Satorp Equity (US$3.5bn)	Structure of Satorp JV follows Islamic Finance principles
Debt >60% of total Project Costs	**7 ECAs** Korea Export Insurance Corporation K-ExIm (Korea) Japan Bank for International Co. operation Nippon Export and Investment Insurance CESCE (Spain) COFACE (France) Euler Hermes (Germany)	US$2.7bn	Direct loans and debt cover
	12 LOCAL COMMERCIAL BANKS	US$1.4bn of both US$ and SAR 16-year sharia compliant debt US$0.5bn equivalent of conventional 16 years RAS debt	Conventional position of the SAR denominated debt is priced below banks' cost of funds Local banks are in a club deal
	19 INTERNATIONAL COMMERCIAL BANKS Credit Agricole Societe Generale KFW Bank Deutsche Bank EDC Sumitomo Mitsui Banking Corporation Bank of Tokyo Mizuho Corporate Bank Standard Chartered Bank Barclays Citibank JPMorgan RBS APICORP Gulf International Bank Riyadh Bank Banque Saudi Fransi HSBC Arab Bank	US$1.6bn of 16-year US$ debt	International banks in a club deal Lending not far above cost of funds
	PUBLIC INVESTMENT FUND	US$1.3bn	Saudi Arabia sovereign wealth fund
	SPONSOR LOAN/ ISLAMIC BOND	US$1bn	This US$1bn was initially to be funded through the first ever Islamic Bond ("Sukuk") but its structuring was not completed when the construction started. Aramco and Total agreed to provide each a senior shareholder loan of almost US$0.5bn to cover first stages of construction. Once finally arranged, the bond carried the same tenor as the rest of the financial package.

Source: Authors' elaboration based on Petroleum Economist 2010 financing of some projects will be finalised and implemented, while others will be dropped.

Beyond the specificities of each financing, there are however a few facts and trends which are true for most Energy projects.

First, to quote the International Energy Agency in its World Energy Investment 2019 report, current investment in Energy is "poorly aligned with future needs and challenges". This is very likely to translate into an increased competition between projects to attract funds in the very near future. Growing investment needs, especially for renewable Energy projects but not only, will require new sources of capital, such as institutional investors. This category of investors is attracted by bond-type investments and stable cash flows, which can be delivered for example through insurance products, the development of which is then likely to flourish in the coming years.

Second, except maybe for nuclear plant projects, there have been significant cost reductions in all Energy projects over the last decade, together with a shift towards shorter construction time (IEA 2019). Here again, this could lead to increased interest from institutional investors, as it lowers the projects' risk level. We could add that development finance institutions have not only played a facilitating role, but have now become key financing actors across all Energy segments.

Finally, most Energy investments are now facing new financing challenges. If the rise in interest rates was to continue, most of the projects could be adversely impacted and sponsors would have to replace the funding traditionally provided by commercial loans with new sources.

Would governmental support to renewable Energy stop, as it seems to be the case in the USA in the coming years, projects would then depend on power purchase agreements or simply merchant power prices. A new source of financing could come from corporate PPAs, currently only accounting for 5% of solar PV and wind investment. Global oil and gas companies are also increasingly active in financing renewable Energy assets, either by investing directly into renewable Energy projects through dedicated subsidiaries or by taking equity participations into renewable Energy companies such as research and development companies focusing on Energy efficiency. In the context of a necessary Energy transition and increasing investment into renewable Energy sources, it will be imperative to understand where new funds are originally stemming from.

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