THEnergy study

Solar-diesel-hybrid power plants at mines: Opportunities for external investors

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Content

1 Introduction

The business case for renewable energy projects in mining is very positive, especially for remote locations. Nevertheless, the number of solar and wind installations that have already been built does not reflect this fact. One of the main reasons is that for renewable energy projects the vast majority of the expenses are investment costs that occur when the project is built. The energy bill has to be paid beforehand and is not proportional to consumption as diesel based electricity. In addition, many mining companies operate with rather short pay-back periods, renewable energy projects are very often long-term investments. Traditionally, they are calculated for investment horizons of 20-25 years. This is another misfit for renewable energy projects and the mining industry.

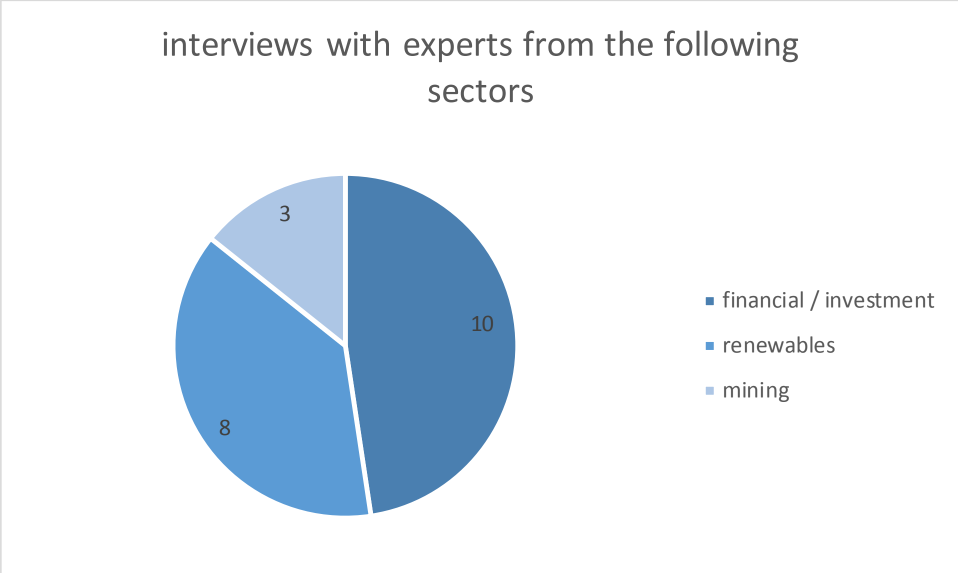
Renewable energy investors are used to these longer pay-back periods. They invest in projects that are long-term, low risk and they expect, as well, lower returns. Normally their projects are based on feed-in-tariffs (FiTs) or long-term power agreements (PPA) and are connected to the grid. Grid-connection is important because it consists of an alternative in case the FiT is withdrawn or the PPA is ended. The latter mainly happens when the contract partner files for insolvency.

It is no surprise that external equity investment for renewable energy projects at mines is already a reality for grid-connected projects. There are many examples in Chile. For remote mini-grids at mines that are not grid connected and for which the business case is especially favorable there are not that many projects. Financing is more difficult and complex for this project type because the revenues depend, to a large extent, on a single customer. In case the customer does not fulfill the contract it is normally not possible to find an alternative off-take for the electricity.

2 Methodology and design of the study

The methodology employed in the study is expert interviews.[1] A total of 21 interviews was conducted with experts from the financial / investment, mining and renewable energy sectors.

[1] Bogner, A., Littig, B., & Menz, W. (eds.) (2009). Interviewing Experts. Methodology and Practice. Basingstoke England : Palgrave Macmillan.



The interviews were conducted by phone or in personal meetings. Most of the experts are from Europe, and the majority have a global perspective on the topic.

3 Benefits and risks of renewable energy in the mining industry

Many mines are located very remotely or in areas where the grid is not very stable. Often mining companies have their own power plants, normally diesel generators. In particular, in remote locations the transport costs of diesel are high and theft during transportation is an additional problem. Ultimately, electricity produced from diesel generators is very expensive. The cost per kWh is frequently above 400 Euro/MWh. Given that the prices of renewable energy, both wind and solar, have decreased considerably during recent years, renewable energy plants seem to be an attractive alternative. Prices between 60 and 120 Euro/MWh are common for wind and solar farms.

Nevertheless, these numbers do not reflect the total costs for remote plants at mining locations, because firstly, these numbers are only valid for easily accessible projects and not for remote locations. Secondly, more importantly these numbers are based on an investment horizon of 20-25 years.

Many mines have a remaining lifetime that is much shorter. In addition, the operation of a mine depends to a large extent as well on the market price of the corresponding raw material. i.e., if for example copper prices are very low, certain copper mines cannot be operated profitably and they are closed down temporarily. This is actually the case for many different mining sectors in mining. As a consequence mining companies calculate internally with a much shorter payback period for investments, often in the range of 4-6 years, sometimes even shorter.

Thirdly, the diesel has to be paid when it is used for electricity generation. Diesel generators can be rented at attractive rates. So timing of the expenses for electricity is related to revenues from selling the raw material. This is completely different for renewable energy projects. The big majority of the expenses are for building the plant. The energy expenses are incurred before the first unit of electricity is generated. Many mining companies do not see electricity generation as one of the core competencies. They rather focus on the mining processes. In many case, they and their investors expect short-term higher returns than what is possible from renewable energy projects.

It is obvious, that financing renewable energy projects by themselves is not a very attractive option for many mining companies.

4 External investments for renewable energy projects in mining

If for mining companies financing renewable energy projects does not seem to be so attractive, external investors have to be taken into consideration. Many large-scale renewable energy projects are actually financed by institutional investors, such as pension funds, insurance companies or sovereign wealth funds.[2] These investors can do without high returns, but are at the same time risk-adverse.

4.1 Risks in externally financing renewable energy projects

The table shows the main risks for renewable energy projects. If the investment is done in a different currency zone, also the exchange rate risk plays an important role.

[2] Kaminker, C., Stewart, F. (2012), The Role of institutional investors in financing clean energy.

Category	Risk type	Explanation
Construction	Loss or damage	Breakage/theft in transit or during installation
	Start-up delays	Revenue losses arising from delays in construction phase
Operation	Loss, damage & failure	Accident, theft, natural catastrophe; underperformance of equipment; manufacturer unable to honour O&M agreement
	Business interruption	Revenue loss arising from failure, damage or extreme weather
Market	Weather	Variability in revenue due to volatility in output
	Curtailment	Regional grid oversupply where power cannot be sold
	Power price	Variation in revenue due to wholesale price volatility
	Counterparty	Default of counterparty in power purchase agreements
Policy	Country	Retroactive support cuts
		War and Civil Strife
		Confiscation, Expropriation and Nationalization (CEN)
		Increase in taxes levied on the project
		Change in regulation

Categorization of main renewable energy risks[3]

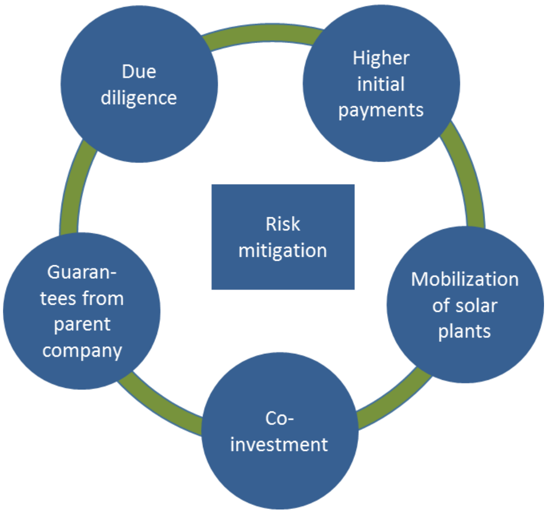
Traditional renewable energy investors have learned to deal with these risks of grid connected projects. The main difference of remote solar-diesel-hybrid projects is that the counterparty risk is much higher, if the project is not grid-connected and if there are no alternative off-takers nearby.

Mines are sometimes put out of service if their costs are above the price that they can achieve on the market. In addition, the mining operation depends very much on access to minerals and metals.

4.2 Strategies for mitigating the counterparty risk

The expert interviews have revealed several strategies of how external investors can deal with the counterparty risks. All solutions have in common that the mine does not have to make the full investment before the commissioning of the power plant. Combining these different solutions can make sense.

[3] Turner, G., Roots, S., Wiltshire, M., Trueb, J, Brown, S., Benz, G., Hegelbach, M. (2013), Profiling the risks in Solar and Wind.



4.2.1 Resource based and market based due diligence

Many renewable energy investors are not experts of the mining industry. It is strongly recommended that they involve external specialists for determining the counterparty risks that arise on the one hand from the mining operations and on the other hand from the mining markets. The external investor needs to conduct a resource-based and market-based due diligence on the mine. The main objective of this is to understand the level of risk that the mining operations are stopped based on economic or resource reasons.

4.2.2 Guarantees from the parent company

The investor needs to check with which legal entity he closes the contract. If the mine is owned by a corporate mining group, it is recommended that not only the specific mine takes full liability. The investor should try to involve the parent company, either as a direct contract partner or as a guarantor. In these cases, the market and financial due diligence has to cover the whole group and not only the mine.

4.2.3 Co-investment

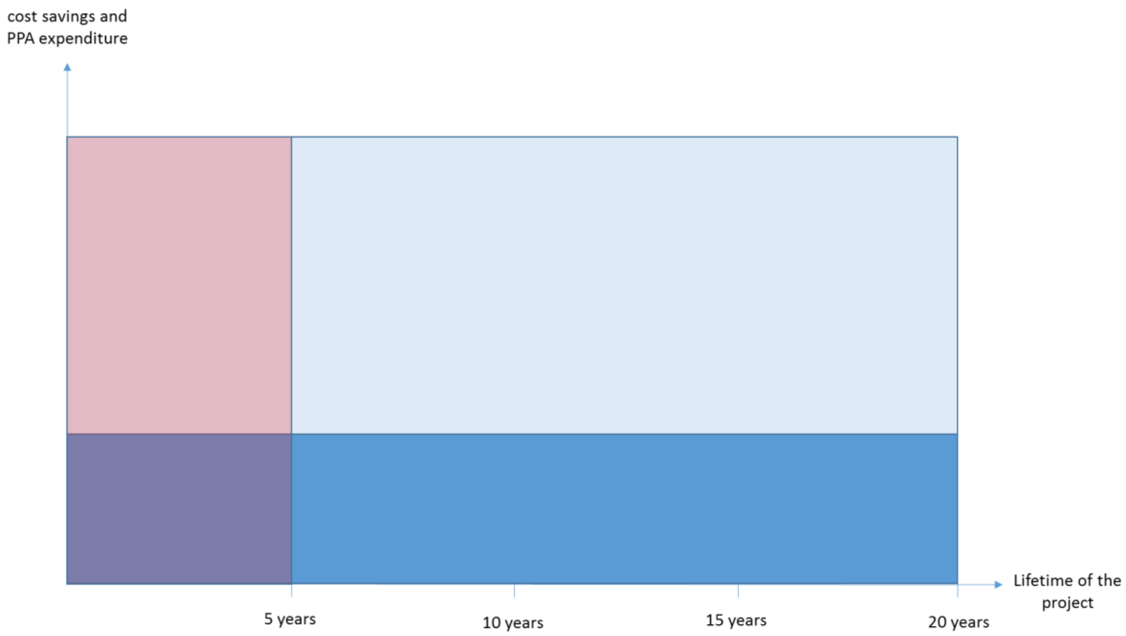
Liability is mitigated to the mining company as well if the contract includes a co-investment of the mining company in the solar plant. In the contract the mining company's share in the solar plant could be part used for guaranteeing the PPA or rental payments and decrease the risk for the power-provide. In addition, a co-investment incentivizes the mining company to evaluate the remaining life-time of the mine realistically and to demonstrate a commitment for that evaluation.

4.2.4 Mobilization of the solar power plant

Traditionally solar power plants are considered as immobile assets. In many business cases the option to dismantle a plant and reinstall it at another location is not even taken into consideration. Warranty agreements of manufacturers frequently do not cover the case that a solar power plant is relocated either. On the other hand in the market an increasing number of concepts have evolved to mobilize also larger solar plants. Solar modules are pre-mounted to substructures of the mounting system, the modules on these substructures are connected and in a next step the pre-assembled elements are containerized. That allows for dismantling and reinstalling the power plant much more quickly and substantially mitigates the counterparty risk, especially for areas where either labor costs are high or it is difficult and expensive to find qualified solar installers. In some concepts the container itself serves as a foundation for a part of the pre-assembled elements and contains inverters, controllers or spare parts. The costs for moving a containerized power plant are in the range of 5-10% of the initial investment costs depending mainly on the origin and target locations.

4.2.5 Higher payments for the rent of power plant or higher PPA-price in the initial phase of the project

Feed-in-tariffs and standard PPAs are stable over the years. Inflation adjustments are sometimes common. For the investor, that means that his initial investment is repaid over the pre-defined duration of the PPA or FiT. Depending on the country this is a period of normally 15-20 years.



An example illustrates how this could be different in case of PPAs or rental agreements for isolated solar-diesel-hybrid-power plants.[4] The dark horizontal boxes represent the PPA payments in a

[4] For simplicity reasons the example does not take interests into accounts and the expected return of the investor is included in the PPA payments.

traditional project over 20 years. They amount to the sum of the imputed investment costs over 20 years and the return for the investor. The total area shows the accumulated avoided diesel costs. In the example, the costs of the solar project are approximately one third of the total cost savings. Given the high counterpart risk for remote solar-diesel-hybrid projects that are not connected to the grid and that cannot be controlled by the external investor, a common negotiation strategy is to reflect this fact in the PPA and bring forward the cash flow accordingly. In the example illustrated above, the reddish boxes have the same size as the horizontal bluish boxes. This reflects that the same investment is taken into consideration. The difference is that the mining company pays during the first five years rates that correspond to the avoided diesel costs. During the first 5 years their cash flow is exactly the same as if they used diesel generators. After that, they receive electricity free of charge. A similar scenario can be constructed for rental or leasing models in which higher rental or leasing rates in the first years repay the investment and afterwards the ownership of the plant is transferred to the mining company.[5]

As a side effect this structure can possibly prolong the lifetime of mines as the electricity is provided free of charge or at lower charges. This has a direct influence on the direct cost structure of mines. In the case that the raw material prices decrease or the production costs are increased due to a more difficult accessibility of the row material sometimes an economic operation with full electricity costs is not possible anymore years before the forecasted end of the mine's lifetime. In some cases the lower electricity cost might reduce the operating costs in such a way that the mine can be operated for longer. This concept does not bring any disadvantages for the mine in the first years, and improves the economics of the mine substantially after the second phase.

Normally the mining company's strong negotiations are to be expected between mining companies and external investors. The figures in reality are not as obvious as in this artificially constructed case. Many input data consists of expectations, e.g., the amount of diesel costs that can actually be avoided depends on the development of the diesel price over several decades.

5 Summary and outlook

The study shows that financing is one of the main bottlenecks for a quick spread of solar-diesel-hybrid power plants in the mining industry. External investment is feasible, but it cannot be translated one to one from traditional FiT- or PPA-models. The main difference is that in isolated locations there are no other off-takers for the electricity in the case that the mining company does not fulfill the contract. In other words, the counterpart risks are much higher than for standard grid-connected projects.

There are several strategies for reducing the counterpart risk. The different strategies might be combined. Two aspects are to be underlined: a mobilization of the solar power plant is a technical solution for mitigating parts of the risk. On the financial side it is to be expected that in the initial project phase the investor requires higher payments in order to minimize the counterpart risk. This is valid for PPAs as well as for rental agreements.

[5] The legal framework differs to a large extend in different countries and needs to be taken into account for each project.

First rental and PPA solutions are already available in the market. A growing number of solar companies and investors see the mining industry as a reliable partner for rental or PPA models. This development is considerably likely to accelerate the extension of solar applications at mines.

About Dr. Thomas Hillig Energy Consulting (THEnergy)

TH*Energy* assists companies in dealing with energy related challenges. Renewable energy companies are offered strategy, marketing and sales consulting services. For industrial companies TH*Energy* develops energy concepts and shows how they can become more sustainable. TH*Energy* combines experience from conventional and renewable energy with industry knowledge in consulting. In addition to business consulting, TH*Energy* is active in marketing intelligence and as an information provider in select fields such as renewables and mining through the platform www.th-energy.net/mining.

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