Argentina confirms 300MW solar auction

Argentina made this auction in the previous edition of PV Tech Power after a series of big solar announcements in Q1, which although lacking in substance, was a welcome signal from a country that had built negligible movement on solar to date. However in the quarter just gone by, the energy ministry has confirmed a 1GW renewable energy auction and a significant 300MW set-aside for solar PV.

The initial announcement was followed by news of a slight two-week delay in the data for publishing results by 12 October this year. Bids will be accepted until 5 September.

There is potential for problems to arise considering the issues seen in the recent Mexican solar auction where there were issues with results due to a faulty internal algorithm.

"It's entirely possible that something happens like that," says Marian Parikh, analyst at GTM Research. "They have already pushed back the publish dates and built in a little bit of a buffer, but I don't think we are going to see something as drastic as Brazil in terms of cancellation."

The signals remain positive in terms of policy structure and progress, adds Parikh, however successful developers will only have a two-year timeframe to complete their projects.

"That is really ambitious for a country that doesn't have much renewables on the ground as it is," says Parikh. "They have a supply deficit that they are trying to cover, and their currency is still attempting to rebound — granted, they have paid back a lot of their creditors in terms of their existing debt."

Countries with Argentina's experience can be expected take a little more time to get projects off the ground even if driven by a renewable energy target of 28% by 2030. "While those are great targets to have, if I think developers may run into problems such as securing financing," adds Parikh. Developers will have access to tax benefits under the Renewable Energy Development Program as well as World Bank guarantees. Nevertheless, Parikh says project completion dates are still likely to be pushed back to late 2018 or early 2019. Delays are less likely to happen if a major developer that is well established in the region takes the whole capacity. Parikh cites Italian energy giant Enel as a possibility given its strong progress in Brazil and other Latin American markets. He claims that if the capacity is shared out between five or six developers then delays are highly likely.

Wind, biomass and small hydro power technologies will also be represented at the auction. The new policy complements Argentina's first movements in Q1, when a renewables policy was introduced and the new president Mauricio Macri awarded plans to establish 15GW of solar in Northern Argentina. There were also early signs of a 7GW development in La Rioja.

Developers will only have a two-year timeframe to complete their projects

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Technical failures in PV projects

Risk assessment | The aim of the Solar Bankability project is to establish a common practice for professional risk assessment, which will serve to reduce the risks associated with investments in PV projects. In this article the project team discusses a key aspect of this work: the development of a methodology for the assessment of the economic impact of failures occurring during operation but which might have originated in previous phases.

Historical performance data for PV systems on which to base technical risk assessments and investment decisions are not easily accessible by some market players, such as installers, PV plant owners, EPC contractors and insurance companies. The reasons for this difficulty are that most PV systems have been operational for only a few years. Low-level cumulative installations in many countries were only reached after 2010, and that there is a tendency among system operators and component manufacturers to keep available performance data confidential.

In addition, performance data is most often not available for PV plants with low nominal power (e.g. residential/commercial market segments up to 250kWP), as the cost of monitoring is still perceived as an added cost. Finally, although the description of failure and corrective measures is common practice in the field of operation and maintenance (in best in paper form), this is not often carried out with a sufficient level of detail in order to derive meaningful statistical analyses because of missing cost information and the lack of a common approach in the assignment of failures to a specific category. For the PV industry, to reach a mature market level, a better understanding of technical risk, risk management practices and the related economic impact is thus essential to ensure investor confidence.

One objective of Solar Bankability is to improve the current understanding of several key aspects of risk management during the project life cycle, from the identification of technical risks and their economic impact, through the process of mitigating and educating those risks among project parties, to transferring those risks through insurance, warranties, preventive maintenance, etc. To achieve this, the Solar Bankability project team has started building upon existing studies and collecting available statistical data of failures with the following aim: 1) to suggest a guideline for the categorization of failures; 2) to introduce a framework for the calculation of uncertainties in PV project planning and how this is linked to financial figures; and 3) to develop a methodology for the assessment of the economic impact of failures occurring during operation but which might have originated in previous phases. The focus of this article will mainly be on the third aspect.

Failures of PV system components

A description of the typical failures at the PV module level was the subject of extensive studies within the first phase of the IEA PVEP Task 13 ‘Performance and Reliability’ and the results were presented in the deliverable review of PV module failures [1]. In that document the most common failures of PV modules are described along with the measurement methods in order to assess the impact on performance safety, with a particular emphasis on visual inspection.

"A better understanding of technical risks, risk management practices and the related economic impact is essential to ensure investor confidence."
Assessment of the economic impact of technical risks: FMEA methodology

The typical approach in risk analysis for technical projects is to apply a classic FMEA. In which the various risks, associated with a certain phase and component, can be prioritized through their risk priority number (RPN). In the FMEA each identified risk is evaluated for its severity (S), occurrence (O), and detectability (D); numbers are used to score each of these evaluation parameters. The RPN is then usually obtained by multiplying these three factors.

The classic FMEA with RPNs, although important, is incomplete and needs to be enhanced to include a method for assessing the cost impact of each risk. A classic FMEA is thus deemed inadequate for this specific objective when the technical risk analyst needs to provide a framework for the calculation of the economic impact.

Figure 1. The risk matrix as implemented in the Solar Bankability project

Regarding the application of cost priority (FMEA) in other fields, many studies have been reported that involve the introduction of a special coefficient called the cost priority number (CPN). To the best of the authors' knowledge, there has been no analysis documented in the literature relating to photovoltaic plants.

A CPN ranking prioritizes risks which have a higher economic impact; however, this might not be applicable to each type of risk. To this extent, technical risks were first listed in the risk matrix. The inclusion of the risks in a risk matrix is considered a fundamental step to allow the possibility of failure data, based on an agreed nomenclature and definition, being shared by all the different stakeholders. For the calculation of the economic impact of risks, which are likely to occur during the implementation phase (i.e. during operation and maintenance), it is important to separate this into loss of income due to downtime, and the costs related to fixing the failure (e.g. repairing or replacing a component).

Loss of income due to downtime

For the calculation of the mixing income due to downtime, the occurrence and severity were calculated following a well-defined procedure. The procedure is designed to allow generalisation and flexibility in order to maximise the use of the methodology. The severity, S, is defined as the total plant's production over one year in the absence of failures. The occurrence, O, is calculated on the basis of the downtime of a specific failure, normalised over the number of components and the total hours.

For the calculation of the costs due to downtime, it is important to consider the loss income as a result of reduced energy production. This can be related to feed-in-tariffs (FIT), to the missing income from power purchasing agreements (PPA), or to the missing savings generated by PV plants installed on roofs/facades which are linked, for example, to the retail cost of electricity. Specifically, the downtime costs are calculated considering the time to detection of the failure, the time leading to the repair/replacement, and the time to fix the problem.

Costs related to fixing the failure

The costs related to fixing the failure derive from the sum of the costs of repair/replacement, detection, staff transport and labour: the calculation is carried out for failures affecting various components. The overall sum of this type of cost is then equal to the cost of monitoring/detection and corrective maintenance. Preventive maintenance can be included as a detection cost, and its impact can be assessed using the methodology and effectively reduces the time to detection.

As a final step, the calculation of the CPN is then given by the sum of the costs due to downtime and the costs due to fixing the failure.

Figure 2. Database used in the Solar Bankability project

Regarding the transition into the various categories allows the calculation of CPNs for very various project phases (e.g. product testing, planning, transportation/installation, CRM, decommissioning) have been included in a risk matrix (Fig. 1), and a methodology has been developed to assess the economic impact of failures on the calculation of the levelised cost of electricity (LCOE) and on business models. This represents an initial attempt to apply a cost-based failure mode and effects analysis (FMEA) as an important step towards increasing confidence in the operation of PV systems based on a large-scale failure analysis. More detailed results of this work are presented in the Solar Bankability's public project report "Technical Risks in PV Projects" (6).

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Multi-Contact: 120GW PV power installed worldwide – a figure that speaks for itself

Over a billion connectors from the Multi-Contact SolarLine range have been providing reliable connections all over the world since 1996. This represents a PV output of over 120GW – almost impossible to believe!

Matthias Mac, head of photovoltaics at Multi-Contact, explains how his important milestone was achieved in a highly volatile market environment.

Matthias Mac, a total of 120GW PV power has been installed worldwide to date with PV connectors from Multi-Contact. What does this figure mean for you as a customer? We are very proud of it, naturally. The figure is simply staggering and unique. At the end of 2015, global solar power amounted to around 230GW – over half of which came from systems with original Multi-Contact connectors. For us, however, the aspect of longevity is also key: PV systems with our connectors are intended not only to produce this fantastic result of 120GW today, but also to provide constant power for years to come. Our products could be described as the backbone of the system and they are not in a perfect working order, the system’s performance can deteriorate dramatically within a very short space of time.

While photovoltaics are currently being strongly promoted worldwide, there is not much point installing even bigger PV systems if they go on to provide only 60% to 70% of their maximum power because second-rate products have been used. Photovoltaics are an extremely important ally when it comes to achieving climate targets all over the world, and we should not weaken their effect if it can be avoided.

The PV power we have achieved is therefore in principle a confirmation of our customers’ trust in our company and in our products: they place us as a market leader with the greatest wealth of experience, a pioneer since the early 1980s. We have achieved this outstanding result within the space of a few years – the most important thing was the exceptionally high and flawless performance of our products, some of which have been in use for 20 years. Evidence such as this from the field tells us so much more than any laboratory test ever could.

What does this figure mean for the industry? It is truly unique. As a comparison, the biggest model manufacturers are currently at around 150GW. We are thus making an essential contribution to positioning solar energy as an alternative renewable energy source, and over the longer term as the central source. At the same time, however, we are aware that cable connectors, junction boxes, and cables) is a small piece in the puzzle of a large PV system and accounts for less than one percent of overall initial costs. That said, the most effective solar panels in the world are no good if top-quality cables are not used to transport this power to where it is needed. When it comes to evaluating the risks associated with the return on investment (ROI), this is still often considerably underestimated. So much can happen: increased contact resistance leads to less power and more heat, components and strings provide less output, they can fail, or a fire can even occur, resulting in increased costs for maintenance and spare parts. If we factor in these aspects over a operational period of 10 to 20 years, it becomes clear that in the long term, quality prevails.

These are also the key criteria when it comes to securing financing for a big PV system: low risk and the highest possible ROI. This rule applies to reliable partners and products, not least in financial terms – and there is no better argument for underscoring the reliability of our products than the 120GW power achieved using our connectors.

How have you managed to reach such a figure? Which partners have you been working with?

One reason is undoubtedly our focus on first-class contact with partners and customers. On top of this, we can also boast over 50 years of core competence with MULTI+. We identify trends at an early stage and have a systematic strategy for product development. As a Swiss company, we naturally focus on quality, and see ourselves as a true solution provider. We also have a wealth of experience in the world’s top markets and are familiar with the prevailing standards for each country. Our sales and service teams are always busy answering questions and carrying out sales tests. Today’s market requirements have evolved on the basis of environmental issues and geographical diversity, but here too, experiences in the field are much more meaningful than laboratory results. And do not forget: 100GW worldwide in the last 20 years! Our products can be found in every corner of the earth – and in very different, sometimes extremely tough, environmental conditions. Our products have extremely low failure rates (99%).

Problems can occur as a result of low-quality or recycled materials, for example, and as a result of poor contact quality. While this is ruled out in our manufacturing processes, our products can of course be affected by external influences, for example transport or poor assembly (especially when crimping) or a crossover connection. A crossover connection is one in which our connector is connected to one from a different manufacturer. A large number of studies and a great deal of experience in the field in recent years have shown clearly that these different connectors are not compatible; TUV Rheinland has stated, for the purposes of certification, that the use of two different connectors invalidates the certification of the individual products. This is not only dangerous (the increased contact resistance leads to a noticeable rise in temperature) but also costly in terms of repair work or even fire, but also means that the product guarantee is no longer applicable and insurance companies may refuse to cover any damage. In addition to this, the legal uncertainty when it comes to liability has a direct negative impact on the overall project reliability and the ROI calculation.

What are Multi-Contact’s strengths, and where does the company stand as an international competitor?

Our connectors make us the undisputed leader in the market – the benchmark. We make no compromises on quality and offer enormous expertise based on over 20 years in contact technology and 20 years in the PV market. We also offer, in the last value for money over the long term, combined with the benefits of consistently available production capability and the financial strength we enjoy as part of the Staubli Group. Our customers value our innovative solutions, the service orientation of our sales teams, and our strong and enduring partnerships in the PV industry throughout the entire value chain. We also attach great importance to a sustainable approach, and have high visibility when it comes to our own intercultural understanding. Another distinguishing feature is our presence in the installation markets and in over 20 countries in the world. These arguments make us an exceptionally reliable partner in the PV industry, both from a technological and a financial perspective.

Looking ahead, which developments or trends do you see approaching, and what is Multi-Contact doing to maintain its role as market leader?

We expect to see increased segmentation in the future, with standard modules for various areas of application and doubtlessly a large market for building-integrated photovoltaics, while classic PV will gradually merge with storage applications. We anticipate further growth and strong growth in the USA, China, Japan, and India, in particular; and attractive growth markets also exist in the MENA region, South America, and Southeast Asia. The central issue will be cost optimization and further development of products – not least because of the increasing numbers of low-cost investors entering the industry and insisting on high quality, sustainable returns, and low risk. We need to stay on the ball, focus on quality issues, and respond to the increasing importance of operational and maintenance services. We can do this by consolidating our planning risk through our work on cost-effective and efficient solutions for our customers' requirements and control the efficiency of operations.
Module failure Failure share
Soiling 23.4% 
Shading 16.6%
EVA discoloration 11.8%
Glass breakage 6.5%
PID 5.0%

Table 1. Share of specific technical risks over all failures; PV modules.

Inverter failure Failure share
Fan failure and overheating 21.8%
Fault due to grounding issues 4.9%
Inverter firmware issue 3.8%
Burned supply cable and/or socket 2.2%
Polluted air filter 3.3%
Inverter pollution 1.5%

Table 2. Share of specific technical risks over all failures; inverters.

generic cases or for plant-specific scenarios, depending on the type of input data available (statistical analysis of failures or specific plant-related failures). The parameters used for the calculation of the CPF can also be specified as country-dependent by applying country-based coefficients to take account of different FIT schemes, retail cost of electricity, annual isolation, cost of labour, etc.

CPFs are given in kV/MPa or in kW/MPa/year and can thus directly give an estimate of the economic impact of a technical risk. The methodology also considers the year of installation, the year of failure and the nominal power in order to be able to run analyses for different market segments and to evaluate the distribution of failure probability once the available data in the database reaches statistical relevance to this type of data granularity. The methodology also considers other statistical parameters, such as the number of affected plants and the number of components affected in affected plants, in this way is possible to understand if a specific failure in PV plant dependent on it is equally present over the entire PV plant portfolio.

The database used for the calculation of the CPF for various technical risks includes for 577 plants, a total of around 450,000 failures, and with an average operating period of around three years (Fig. 2). The number of components totals 24 million (including 2 million modules and 12 million inverters). If all market segments are considered, the most important failures (in terms of occurrences for PV modules are: soiling, shading, EVA discoloration, glass breakage and potential induced degradation (PID) (Table 1). In the case of inverters, the failures are fan failure and overheating. Fault due to grounding issues, inverter firmware issues, burned supply cable and/or socket, polluted air filter and inverter pollution (Table 2). Overall, the occurrence per year for affected components is around 12% for PV modules (including shading and soiling) and 9% for PV inverters.

To be able to translate the information about failure occurrence into a CPF, two scenarios were established: 1) a scenario in which the failure was never detected over a one-year period; and 2) a scenario in which the failure, once identified, was fixed within a month. The sum of the CPFs calculated for the two scenarios was defined as the base-case scenario for the analysis. In terms of CPF, the most significant failures for PV modules turn out to be glass breakage followed by PID, small tracks, defective backsheet, delamination, and hotspot, exporting to total costs of 654$/kW/year. The analysis also shows that it is important to consider the evolution of the impact of failures on the performance loss over the course of the problem. Power losses will increase over the years, and the existing or impending failure could also pose safety risks.

Another important aspect is represented by the spread of the failures over the PV plant portfolio included in the database. If only the PV plants where the failures occur are considered, the results are remarkable: the overall occurrence might be low but when the failure occurs it can have an important economic impact on the affected plants. The costs relating to theft of modules can then increase from 654$/kW/year when considered over the whole portfolio, to 434$/kW/year for the affected plants; similarly, the PID-related costs can increase from 65 to 614$/kW/year.

Mitigation measures

Once the base-case scenario has been defined and the overall CPF calculated, the next step is to assess the effectiveness of the combination of various mitigation measures in terms of CPF reduction. In this way, it is possible to understand who bears the risks and who ultimately bears the costs of PV component failures.

Figure 3. CPF values resulting from the statistical analysis for the top ten technical risks for PV modules. The red line represents the cost/kWp/year due to downtime in the worst and base case scenarios respectively.

A lower CPF value for the never-detected scenario does not mean that this strategy is more cost-effective than fixing the problem

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Table 3. General recommendations.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Phase/field</th>
<th>Identified critical technical gaps</th>
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<tbody>
<tr>
<td>Year 0</td>
<td>Procurement/product selection and testing</td>
<td>EPC technical specifications that are insufficient to ensure that selected components are suitable for use in the specific PV plant environment of application.</td>
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<td>Inadequate component testing to check for product manufacturing deviations.</td>
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<td>Planning/lifetime energy yield estimation</td>
<td>Effect of long-term trends in the solar resource is not fully accounted for.</td>
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<td></td>
<td>Exceedance probabilities (e.g. P80) are often calculated for risk assessment under the assumption of a normal distribution for all elements contributing to the overall uncertainty.</td>
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<td></td>
<td>Incorrect assessment of degradation rate and behaviour over time in the yield estimation.</td>
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<td>Installation/construction</td>
<td>Incorrect availability assumption in calculating the initial yield for the project investment financial model (e.g. O&amp;M plant availability guarantees).</td>
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<td>Installation/provisional and final acceptance</td>
<td>Absence of standardised transportation and handling protocols.</td>
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<td>Inadequate quality procedures in component unpacking and handling by workers during construction.</td>
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<td>Missing intermediate construction monitoring.</td>
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<td>Risks during Operation</td>
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<td>Inadequate protocol or equipment for plant acceptance visual inspection.</td>
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<td>Missing short-term performance (e.g. performance ratio - PR) check at provisional acceptance test, including proper correction for temperature and other biases.</td>
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<td>Missing final performance check and guaranteed performance.</td>
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<td>Incorrect or missing specification for collecting data for PR or availability evaluations; incorrect measurement sensor specification, or incorrect irradiance threshold to define the time window of PV operation for PR/availability calculation.</td>
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<td></td>
<td>Maintenance</td>
<td>Missing or inadequate maintenance of the monitoring system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Module cleaning absent, or cleaning too infrequent.</td>
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</tbody>
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David Moyer coordinates the activities of the Photovoltaics Systems Research Group of the Institute for Renewable Energy, EUREC, Bolzano, Italy. His work focuses on solar resource assessment, performance, and reliability of PV systems and modules, building integration of PV systems, and PV integration in the grid.

Caroline Vangelis is a senior PV consultant and technology expert at 3E PV, Belgium. The scope of her work covers technical due diligence and risk assessments for PV project development and investment. Her key responsibilities are in PV module and inverter manufacturing and product quality assessments. She was previously a research project manager at the Energy Research Center of the Netherlands, specializing in the development and technology transfer of advanced module technologies.

Unlike Jahn graduated in physics and tests various research and development projects in the business area of solar energy of the TÜV Rheinland Group in Cologne, Germany. Her work focuses on developing PV module technologies and on PV system performance analysis. She is a project manager of an International Expert Group examining PV system performance and module reliability of the PVPS programme of the International Energy Agency (IEA).

After 12 years' international sales and marketing experience in the chemical sector, Matthias v. Armanzeg joined the PV Industry in 2004 as a senior strategic advisor. In 2009 he founded ACECO Solar, which offers technical, commercial, and financial advisory services with an integrated perspective on solar bankability and risk management, including feasibility studies, due diligence, expert opinions, and management of insurance claims.

Leanne Thomas Theologis has been working at SolarPower Europe Business since the beginning of 2012. As a senior advisor he has been involved in areas that are directly linked to the PV industry, market, quality, research and sustainability, with further contributions to, and involvement in, grid integration, storage and electricity market design topics. Prior to that he worked as a research engineer. Investigating the impact of high penetration levels of PV on the European grid under certain technical specifications.

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