Webinar "Stabilizing grid operations through storage & forecasting of renewable generation"

Q&A

Answers by ABO Wind, The World Bank Group, Clean Horizon and Reuniwatt

Risk Mitigation Tender (RMIPPPP)

Q. What is the risk mitigation tender all about?

A. ABO Wind: RMIPPPP tender was about filling the short-term supply gap, alleviate the current electricity supply constraints and reduce the extensive utilisation of diesel-based peaking electrical generators.

A. Clean Horizon: The risk mitigation tender is about procuring dispatchable power in South Africa.

Q. As the RMIPPPP doesn't allow charging the battery from the grid, what are the sources for battery charge on cloudy days?

A. ABO Wind: RMIPPPP request for proposals was aimed at procuring dispatchable power from various sources, so the charging could only happen independent of the Eskom grid. To achieve this, IPP's (Independent Power Producers) who took part used various technologies such as solar PV, wind and gas.

A. Clean Horizon: In the case of the risk mitigation tender, it is not allowed to charge the battery from the grid, so it can only be charged from on-site technologies such as wind, solar or gas.

Q. What were the criteria used in site determination?

A. The World Bank Group: Eskom criteria for installation of BESS (Battery Energy Storage System) at their substations were: land availability, current/forecasted load flow issue at the substation, and existing or future wind/PV IPPs connected to this substation. The lead time to obtain the environmental approvals was also a critical aspect.

THE ENERGY MARKET IN SOUTH AFRICA

Q. Can you give more hints about how you do your grid flexibility studies? How are the batteries helping to that? How will the energy market pay for them?

A. The World Bank Group: The funds Eskom used for the demonstration program were climate funds derived from the Clean Technology Fund. Eskom used these to pilot battery storage in a demonstration project. We tried to maximize the value of battery storage in this public project, but

from a system operator point of view it was pivotal to use the best state-of-the-art technology at a competitive cost, based on an international benchmark. Eskom did a supply, installation and O&M contract, and is owning the batteries, which are under construction right now. Of course, this is different from an IPP, trying to maximise their benefit from the PPA (Power Purchase Agreement) contract. The KPIs (Key Performance Indicators) we designed with Eskom are based on previously executed load flow modelling and planning models. Eskom had a technology-neutral approach, but there was a need for energy storage. Keep in mind that this was a pilot project, and future projects will be more commercially-oriented.

Q. How much storage is needed in South Africa in the next 5 years? Is there a published plan? And what are the plans for CSP (Concentrated Solar Power)?

A. The World Bank Group: The Government of South Africa has published an Integrated Resource Plan (IRP) 2019-2030, showing the needs by technology in the near future. We understood that this IRP is being updated.

Q. How to track the various tenders specifically for Energy Storage or CSP in the South African market, and how does the World Bank support?

A. The World Bank Group: Public tenders are posted on Eskom Tender Bulletin or IPP Office website. When projects are financed by DFIs (Development Finance), tenders are also posted on https://devbusiness.un.org/.

Q. Are you working on systems that include storage other than batteries?

A. ABO Wind: ABO Wind is technology agnostic. However, we have projects in Lithium-ion batteries and hydrogen technologies. We have evaluated other technologies for our pipeline

A. Clean Horizon: Clean Horizon is a consulting company and, as such, we are technology agnostic, we work with a wide range of technologies including gravitational storage, flow batteries, flywheels, hydrogen.

A. The World Bank Group: In our Energy Storage Partnership, we study all energy storage technologies. On Eskom side, BESS and pump hydro are part of the technologies in discussion.

Q. What is the LCOE (Levelized Cost of Energy) of a 10 MW PV plant + storage (Li-ion) 3MW?

A. Clean Horizon: The answer depends on a number of technical and financial parameters such as:

- Cost of PV
- Cost of storage
- Solar radiation
- Energy storage system discharge duration (typically 1h to 4h)
- Potential tax credits or incentives (such as the Investment Tax Credit (ITC) shown in the presentation)

A rough order of magnitude is that the LCOE stands between USD 50 /MWh and USD 150 / MWh for a PV plus storage system.

A. Reuniwatt: LCOE is driven by insolation, CAPEX (Capital Expenditure) and OPEX (Operational Expenditure). Both are changing with location and market conditions. Please refer to the latest published tender results to get an impression. LCOE shall be (slightly) under those numbers, otherwise the IPPs would not operate profitably.

Q. Would you be interested in developing solar projects in the Dominican Republic? And if so, which will be the requirements to fulfil?

A. ABO Wind: ABO Wind have offices in South Africa, Tanzania and Tunisia. These are the focus areas in Africa at the moment. However, we have evaluated opportunities in other countries.

A. Clean Horizon: Clean Horizon does not develop any solar project but would be glad to work with you in sizing or procuring the storage component.

A. Reuniwatt: We do not develop projects, but we offer our services globally.

BATTERY STORAGE

Q. Does the battery operate off grid? If yes, what is the response time to transfer between sources?

A. Clean Horizon: A battery storage system can absolutely operate off grid. Typical response time is 150 milli seconds.

Q. How do you dispose the batteries once they reached the end of their life span? Can we recycle Lithium batteries?

A. Clean Horizon: It is possible to recycle batteries even though the cost of recycling it fully is still relatively high.

Q. How long did your analysis to set up the batteries take?

A. Clean Horizon: The design of a hybrid system is typically a month of work on our side once we have all the input parameters.

A. The World Bank Group: Eskom hired an expert consultancy firm. We did a one-year due diligence to analyse the load flows and the preferred sites from a list of 48 sites. It took one year, because in parallel we were running the procurement specifications – that's why the technical due diligence took quite long. Another reason is that the power system is quite complex.

FORECASTS

Q. How does the forecast account for the uncertain climate change impacts expected, coupled with the already stochastic nature of solar and wind energy?

A. Reuniwatt: We use satellite data for forecasts for up to 6 hours and for longer horizons numerical weather models. The climate change can be proven by looking at the long-term empirical data, but does not impact our ability to forecast.

Q. When you are doing forecasts and system energy generation, do you generate simulation for P90, P70 or P50? And why?

A. Reuniwatt: When engaging with a customer we agree in an interface control document all required inputs, update frequencies, time horizons and formats. If the customer requires different probabilities, we can implement this. In most cases, only one irradiation or power forecast is provided which may be subject to further conditioning including caps and thresholds.

Q. Has it ever happened to you to have a year with a generation under P90 simulation results?

A. Reuniwatt: Annual irradiation varies. Per definition, a P90 irradiation is reached in 9 out of 10 years. So yes, statistically there is the occasional year where generation is under P90. However, be aware of how to compare. The projected yield based on a PVSYST or SAM (System Advisor Model) simulation may be impacted by many parameters, e.g. weather data, assumed vs real losses and, obviously, plant curtailment and availability.

Q. Who is paying penalties in the case of variations between yield forecast and real energy generation?

A. Reuniwatt: The IPP is the operator of the plant who finances, operates and receives the plant revenue. In turn, it also carries the operation risk for underperformance.

Q. How is the forecast relayed to Eskom? Is there an API (Application Programming Interface) for real-time interaction?

A. Reuniwatt: We do offer API data connections as a standard. Alternatively, we can also deliver data through an SFTP (Secure File Transfer Protocol) server or via email (the latter is a basic and workable approach, but we do not recommend it).

Q. What are the technologies used for the forecasts? Do we need an instrument on site?

A. Reuniwatt: We apply different tools for different time horizons. Sky cams for minutes, satellite data for hours and numerical weather models for hours and days. Minute forecasts are needed for ramp penalty avoidance (on grid) and fuel savings (off-grid). If you do not have these requirements, you do not need a local installation.

Q. What is the typical error for minutes/hours/days forecasting? Is the accuracy the same for any location worldwide? Does it make sense to think about month/year forecasting with the lowest error level due to climate change issues?

A. Reuniwatt: The accuracy of the forecasts strongly depends on several parameters: the local climate, the concerned time horizon, the metric used... Therefore, a single answer does not work for any place in the world. The accuracy depends on a lot of variables, but nevertheless, some systems/methodologies can keep the accuracy level doing some on-site adjustments.

Q. Does the yield forecast represent energy or power commitments? In other words, besides providing the forecasted energy generation for a specific time interval, is it necessary to provide a constant power value? And if a certain power variability is allowed, is there a limit in the maximum and minimum power injection during that time?

A. Reuniwatt: The forecast can be based on irradiation only or can also calculate the expected power plant energy for the forecast period. The requirements of the grid operators differ. In solar plus storage applications, a constant power value may be an agreed requirement. For power plants without storage, the output will naturally vary with the irradiation, temperature and cloud movement. Typically, for every hour, the forecasted energy is submitted and then compared with the real produced energy. A deviation of +-10% (example South Africa) will then not be penalized. In other countries (example Kenya), there are rules which limit the produced energy commercially: e.g. the energy generated any given hour which is surpassing the forecasted energy for that hour, is not being paid.

Q. Do you work with so-called "offline forecasts", where one simply uses the generated PV data to produce a short-term forecast using statistical methods? How do these compare to forecasts created with additional information, i.e. cameras or other sensors?

A. Reuniwatt: Yes, we do work with "offline forecasts", using directly the live generated PV data (irradiance from on-site sensors and actual power production data). These data are injected into our machine learning algorithms to generate reliable short-term forecasts (1 min to 1 hour ahead). However, there are 2 drawbacks from these statistical forecasts, such as:

- Although they can sometimes reach a performance close to the ones delivered by additional information (cameras, satellite, etc ...), they never beat such algorithms. This could have a significant impact on projects where each % in performance has a significant financial cost.
- The point above is only valid when we evaluate the performance in terms of statistical metrics like nMAE (normalised Mean Absolute Error) or nRMSE (normalised Root Mean Squared Error). However, if we consider more operational metrics like drop detection, the statistical models will never allow to capture such features. Only forecasts based on cameras or satellite data will be able to capture such events.

OTHER

Q. Are your products & services available for smaller systems? I'm thinking of 100 - 200 kW PV used for an EV (Electric Vehicle) charging station.

A. Clean Horizon: As long as there is a storage component, Clean Horizon can support but we typically serve clients for MW scale projects.

Q. What opportunities for students/interns do you have?

A. ABO Wind: We have had opportunities for students/interns in the past, and we will advertise when opportunities become available. For hydrogen we will be partnering with local Universities on knowledge and technology transfer.

A. Clean Horizon: Always a position open, please reach out!

A. The World Bank Group: With the number of projects to be developed in South Africa, our expectation is that a lot of bright minds will be needed. My advice would be to just knock on the doors of IPPs (listed on IPP Office website), and submit your offer to support them.

A. Reuniwatt: Reuniwatt offers student internships in meteorology, machine learning and related topics. To find out more, take a look at our internship page: https://reuniwatt.com/en/master-student-internships-data-science-for-renewables/

Q. How can I contact you?

A. If you have questions concerning the content of this webinar you can contact our speakers Mokebe Tutubala, Frederic Verdol, Corentin Baschet and Thomas Mart directly– we are happy to answer your questions!

For Reuniwatt communication in French, please refer to info@reuniwatt.com.

For any other questions, be sure you will be forwarded to the right counterpart when contacting us here:

ABO Wind	https://www.abo-wind.com/en/extra/contact.php
The World Bank Group	https://www.worldbank.org/en/country/southafrica
Clean Horizon	https://www.cleanhorizon.com/contact
Reuniwatt	https://reuniwatt.com/en/contact-us/