IREK
Innovation and Renewable Electrification in Kenya

Perspectives on hybrid PV/wind mini-grids for rural electrification in Kenya

Can the different diurnal production profiles of solar PV and wind power make the combination of these technologies in hybrid mini-grids relevant for rural electrification purposes in Kenya? Why is the uptake of small wind power not increasing concurrently with the on-going mini-grid expansion? What are the barriers and bottlenecks for diffusion of hybrid PV/wind mini-grids? This note highlights the work and findings of a study in which qualitative and quantitative methods were combined to answer these questions.

During a three-month placement at ACTS in Nairobi September-December 2018, Rasmus Magni Johannsen from Aalborg University investigated the potential for diffusion of hybrid PV/wind mini-grids in Kenya. This included engagements and discussions with a variety of stakeholders and techno-economic modelling. During the period a total of 12 interviews and meetings were conducted with key stakeholders from the Kenyan mini-grid sector in addition to five site visits; four off-grid sites and one grid connected mini-grid.

The following are some of the key take-away points:

Industry opinion and perceived potential for hybrid mini-grids:

- The environment for diffusion of hybrid mini-grids in Kenya is overwhelmingly negative - a result of extensive systemic, technical and economic barriers. The so far low diffusion rates of hybrid PV/wind mini-grid solutions are a result of both industry perception and technological complexity.
- Wind power is not a significant part of the current electrification agenda, decision-making processes, or feasibility studies for neither public nor private projects.
- While the capacity for mini-grid development is high, the technology-specific capacity for wind power is insufficient for development of hybrid PV/wind mini-grids. This includes both a lack of skilled technicians and engineers capable of conducting the required feasibility studies.
- The lack of regulatory framework, political goals, and strategies are a cause of uncertainty and hinders both mini-grid in general and hybrid PV/wind mini-grid development.

Site visits - Ringiti and Ndeda, Lake Victoria:

- Establishing a profitable business case for mini-grids as a private developer is difficult due to the low electricity demands in rural areas. Finding ways to encourage and incentivize productive use of energy will be essential going forward.

- There are no immediate technical concerns or issues of compatibility with integrating wind power into typical Kenyan mini-grids.
- The remote locations of most mini-grid sites pose significant challenges, something that is further exacerbated when wind power is included due to the higher maintenance requirements of wind power compared to PV. Low maintenance and ease of access to spare parts will be key parameters for SWTs in the Kenyan market.

Techno-economic modelling:

- The feasibility of hybrid PV/wind solutions have been investigated by back-testing an existing mini-grid on Ringiti island located in Lake Victoria in western Kenya. The simulation and optimization tool HOMER was used for this analysis in which various mini-grid configurations were assessed on technical and economic parameters.

- At wind speeds >4.5 m/s hybrid PV/wind mini-grids are the preferable solution. For average wind speeds >6 m/s the optimal system configuration does not include a diesel generator.

- At wind speeds averaging 5.5 m/s hybrid PV/wind mini-grids can reduce the LCOE (levelized cost of energy) by 7 to 10 % and battery storage requirements by 11 to 29 %.

- The additional investment cost of wind power in mini-grids in Kenya has very minimal influence on the initial capital cost due to the possible reduction in PV and battery capacity (and related cost-reductions) arising from introduction of wind in the system.

Hybrid PV/wind mini-grids do show both technical and economic promise and could potentially provide the necessary use-case to increase uptake of small wind. However, the contribution from wind power is limited and will most likely remain a supplement to the powerful solar resource as opposed to a stand-alone solution. Hybrid PV/wind solutions are largely disregarded as a viable solution by key stakeholders in Kenya, and the diurnal complementarity of solar PV has so far been unknown.

Going forward, the push for a more formalized regulatory framework and strategies for small wind and hybrid solutions should be continued. Development of local technological capacity in Kenya should be supported by establishing formalized training programs for wind power technicians, similarly to what have been done for PV. Site specific assessments should be conducted for the future K-OSAP mini-grids and similar projects, including the possibility of hybrid PV/wind solutions.

The study has been supervised by Rebecca Hanlin and Poul Alberg Østergaard, members of the IREK research team. Additional feedback and discussions with senior Advisor Margrethe Holm Andersen, Associate Professor Rasmus Lema from Aalborg University, and PhD Fellow at Moi and Aalborg University Faith Wandera Hamala has been valuable to the work conducted. Involved external organisations include: Renewvia Energy, Solargen Technologies, PowerGen Renewable Energy, Kenya Climate and Innovation Centre (KCIC), Rural Electrification Authority (REA), I-DEV International, Strathmore ERC, Access2Innovation (A2I), Peoples Portable Power (PPP).

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