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Assessment of Wind Energy Potential for Power Generation in Northern Ethiopia: A 2013 Case Study

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| Abstract

Ethiopia struggles to meet electricity demand, with many in its northern regions lacking grid access due to remote terrain. Utilising indigenous renewable resources like wind is a strategic priority for sustainable power generation and rural development. This short report assesses the wind energy potential for electricity generation in selected sites within Northern Ethiopia. Its primary objective was to evaluate site-specific wind characteristics and estimate the theoretical power generation capacity to inform energy planning. The assessment used wind speed data collected at three meteorological stations in the Tigray region. Data were analysed statistically to determine average wind speeds, wind power density, and directional distribution. The Weibull distribution function modelled wind speed frequency. Theoretical energy output was estimated for a generic small-scale wind turbine. Analysis indicated a viable wind resource at two of the three sites. The most promising site exhibited an annual average wind speed of 5.8 metres per second and a predominant wind direction from the northeast. The estimated annual wind power density at this location was 180 watts per square metre, suggesting suitability for small-scale power generation. The study confirms modest but usable wind energy potential in parts of Northern Ethiopia. While not all sites suit large-scale wind farms, the resource is sufficient to contribute to decentralised, off-grid electrification for remote communities. Further long-term data

collection is recommended to reduce uncertainty. Feasibility studies for pilot projects using small wind turbines at the promising sites should be conducted. Policy mechanisms to support decentralised renewable energy investments in the region are also advised. Wind energy assessment, renewable energy, power generation, Ethiopia, off-grid electrification This report provides a site-specific evaluation of wind resources in Northern Ethiopia, offering foundational data to guide the development of decentralised wind power generation for rural electrification.
