Zambia solar energy

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Solar resource and PV potential of Zambia: Solar Resource Atlas. Washington, DC: ...

accurate solar resource and meteorological data, used in solar energy yield ...

With its year-round sunshine and geographical location, Zambia is well ...

Over the past decade, the cost of renewable energy has been declining steadily. The weighted average of the levelized cost of electricity at the global level fell by 15% for wind and 13% for solar energy in 2021 alone (Irena 2022). Over the past 5 years, the cost of solar energy has been declining at the rate of 13% per year while it was 7% for onshore wind energy (Lazard 2020). These trends have the potential to incentivize carbon neutrality and contribute to tackling the climate crisis by reducing reliance on fossil fuels (Pfeifer et al. 2021; Luderer et al. 2021).

While critiques of renewable energy cite the spatiotemporal variability of wind and solar radiation as a weakness to a dependable electricity grid (Diesendorf and Elliston 2018), this shortcoming can be overcome by renewable energy mixes including wind, water, and solar power. Furthermore, technological advancements such as innovative energy storage, and optimized management techniques show promise of turning wind and solar energy resources into dependable electricity grids. Indeed, renewable energy sources like solar and wind energy are constantly being replenished at a higher rate than what humans can consume.

Many countries in the developed and developing world are turning to renewable energy as a pathway to climate change mitigation. The European Union for instance is accelerating the take-up of renewables to significantly contribute to the reduction of net greenhouse gas emissions by at least ~ 55% before the end of 2030 (EU 2022). In Africa, many countries including but not limited to South Africa, Nigeria, and Kenya have also set strong emissions-reduction targets. Zambia has also committed to reducing emissions by 25% by 2030 (USAID 2015). Overall, Africa has committed to cutting 32% of emissions by 2030 (Abudu et al. 2023).

The overarching objective of this study is to explore future variations of climatic variables that are relevant to future photovoltaic solar power resources (PVRes) in Zambia. While much of Zambia experience roughly similar climate characteristics due to the plateau that characterizes the country"s topography (Fig. 1A), a few climatic differences exist, and these can be classified into four main categories of the K?ppen-Geiger classification (Peel et al. 2007):

Tropical Savanna The Tropical Savanna climate which is classified as Aw in the K?ppen-Geiger classification covers Kalabo district, parts of Shang"ombo, and Mongu in the Western Province of Zambia (Fig. 1B). In the Eastern Province, Katete, Petauke, and parts of Chipata are also classified as Tropical Savana. These areas generally experience a pronounced dry season characterized by monthly rainfall averaging 60 mm (Africa

Groundwater Atlas 2019).

Arid Steppe This climate zone covers the semi-arid region of Livingstone, Kaloma, Choma, and parts of the Luangwa valley (Fig. 1B). While the rainfall in these areas is not as low as that of desert climates, it is usually less than potential evapotranspiration and can, thus, be described as semi-arid.

Temperate with dry winters (generally June-August, see Marshall 2017) and warm summers The Cwb climate of Zambia mainly covers the northern tip of the country bordering the Democratic Republic of the Congo and Tanzania (Fig. 1B). These areas include Kaputa, Mpulungu, and Mbala. Given their high elevations, temperatures are usually lower than across the rest of the country.

Temperate with dry winters and hot summers Classified as Cwa in the K?ppen-Geiger classification (Peel et al. 2007), this climate zone covers the rest of the country which is mainly characterized by dry winters and wet summers.

Overview of the study area showing: A the location of Zambia in Southern Africa (green square). The grey shading indicates topographical variations across the region based on the Global Land 1 km Base Elevation (GLOBE) digital elevation model (Hastings and Dunbar, 1999). The blue shading shows the location of major water bodies, B climatic zones of Zambia were developed using the Climatic Research Unit Time Series Version 3.21 (CRU TS 3.21) dataset produced and maintained by the Climatic Research Unit of the University of East Anglia (Jones and Harries 2013). The precipitation and temperature CRU data used to produce the Climatic Zones of Zambia are for the period 1951-2010 (Africa Groundwater Atlas 2019)