

Malawi

National Electrification Rate [1]

- National: 13%
 - Urban: 58%
 - Rural: 4%
-

Population

- Total: 19.2 million [2]
- Urban ratio: 16.9% [2]

Population growth

- Medium population growth: 2.7% [2]
 - High population growth: 3% [2]
-

Average household size, urban: 3.5 people [3]

Average household size, rural: 4.1 people [3]

Average electricity consumption per

- Household: 912 kWh/year
- Capita: 240 kWh/year (Tier 4) [1], [4]

Low demand target: U4-R1

High demand target: U5-R3

Off-grid technology cost [5]–[9]:

- Expected PV mini-grid cost: ~2950 \$/kWp
 - Expected Hydro mini-grid cost: ~3000 \$/kWp
 - Expected Wind mini-grid cost: ~3750 \$/kWp
 - Expected PV stand-alone (or SHS) costs:
 - o ~9620 \$/kWp if kW < 0.02
 - o ~8780 \$/kWp if 0.02 < kW < 0.05
 - o ~6380 \$/kWp if 0.05 < kW < 0.1
 - o ~4470 \$/kWp if 0.1 < kW < 1
 - o ~6950 \$/kWp if kW > 1
-

Grid generating cost

- Expected on-grid cost: 0.047 \$/kWh [10], [11]

T&D costs [12], [13] [14], [15] [8], [16]–[21]:

- HV line (69-132 kV): ~53000 \$/km
- MV line (11-33 kV): ~7000 \$/km
- LV line (0.2 – 0.4 kV): ~4250 \$/km
- HV to MV substation (1000 kVA): ~25000 \$/unit
- MV to MV substation (400 kVA): ~10000 \$/unit
- Service transformer (50 kVA): ~4250 \$/unit

Grid generation capacity cap per year: ~54 MW/year

Grid connection limit: ~2.5% population/year

References¹

- [1] IEA, IRENA, UNSD, WB, WHO (2019), "Tracking SDG 7: The Energy Progress Report 2019, Washington DC".
- [2] United Nations | DESA Population Division, "World Population Prospects - Population Division - United Nations." [Online]. Available: <https://esa.un.org/unpd/wpp/>. [Accessed: 27-May-2019].
- [3] D. Mentis *et al.*, "Lighting the World: the first application of an open source, spatial electrification tool (OnSSET) on Sub-Saharan Africa," *Environ. Res. Lett.*, vol. 12, no. 8, 2017.
- [4] IEA, "World Energy Balances." [Online]. Available: <https://www.iea.org/statistics/balances/>. [Accessed: 3-May-2019].
- [5] International Renewable Energy Agency, "Renewable Power Generation Costs in 2017," IRENA, Abu Dhabi, UAE, 2018.
- [6] IRENA, *Innovation Outlook: Renewable Mini-Grids*. 2016.
- [7] IRENA, "Solar PV in Africa: Costs and Markets," 2016.
- [8] A. Korkovelos *et al.*, "The Role of Open Access Data in Geospatial Electrification Planning and the Achievement of SDG7. An OnSSET-Based Case Study for Malawi," *Energies*, vol. 12, no. 7, p. 1395, Apr. 2019.
- [9] A. Korkovelos *et al.*, "A Geospatial Assessment of Small-Scale Hydropower Potential in Sub-Saharan Africa," *Energies*, vol. 11, no. 11, p. 3100, Nov. 2018.
- [10] C. Taliotis *et al.*, "An indicative analysis of investment opportunities in the African electricity supply sector - Using TEMBA (The Electricity Model Base for Africa)," *Energy Sustain. Dev.*, vol. 31, pp. 50–66, 2016.
- [11] I. Pappis, "Electrified Africa – Associated investments and costs," 2016.
- [12] Energy Sector Management Assistance Program (ESMAP), "Model for Electricity Technology Assessment (META)." The World Bank, Washington D.C, 2014.
- [13] R. Karhammer *et al.*, "Sub-Saharan Africa: Introducing Low Cost Methods in Electricity Distribution Networks," *ESMAP Tech. Pap.* 104/06, no. October, 2006.
- [14] World Bank, "Reducing the cost of grid extension for rural electrification," Washington, D.C, Feb. 2000.
- [15] B. J. van Ruijven, J. Schers, and D. P. van Vuuren, "Model-based scenarios for rural electrification in developing countries," *Energy*, vol. 38, no. 1, pp. 386–397, 2012.
- [16] D. Mentis *et al.*, "Lighting the World: the first application of an open source, spatial electrification tool (OnSSET) on Sub-Saharan Africa," *Environ. Res. Lett.*, vol. 12, no. 8, 2017.
- [17] F. F. Nerini, O. Broad, D. Mentis, M. Welsch, M. Bazilian, and M. Howells, "A cost comparison of technology approaches for improving access to electricity services," *Energy*, vol. 95, pp. 255–265, 2016.
- [18] A. Korkovelos, M. Bazilian, D. Mentis, and M. Howells, "A GIS approach to planning electrification in Afghanistan," Washington D.C, 2017.
- [19] The International Energy Agency (IEA), "Energy Access Outlook 2017: From Poverty to Prosperity," International Energy Agency, Paris, France, 2017.
- [20] J. F. Kappen, "Project Information Document-Integrated Safeguards Data Sheet - Madagascar - Least-Cost Electricity Access Development Project - LEAD - P163870," 2019.
- [21] KTH division of Energy Systems Analysis & SNV, "Electrification pathways for Benin - A spatial electrification analysis based on the Open Source Spatial Electrification Tool (OnSSET)," Stockholm, Sweden, 2018.

¹ For additional information refer to GEP data & cost assumptions guide.