

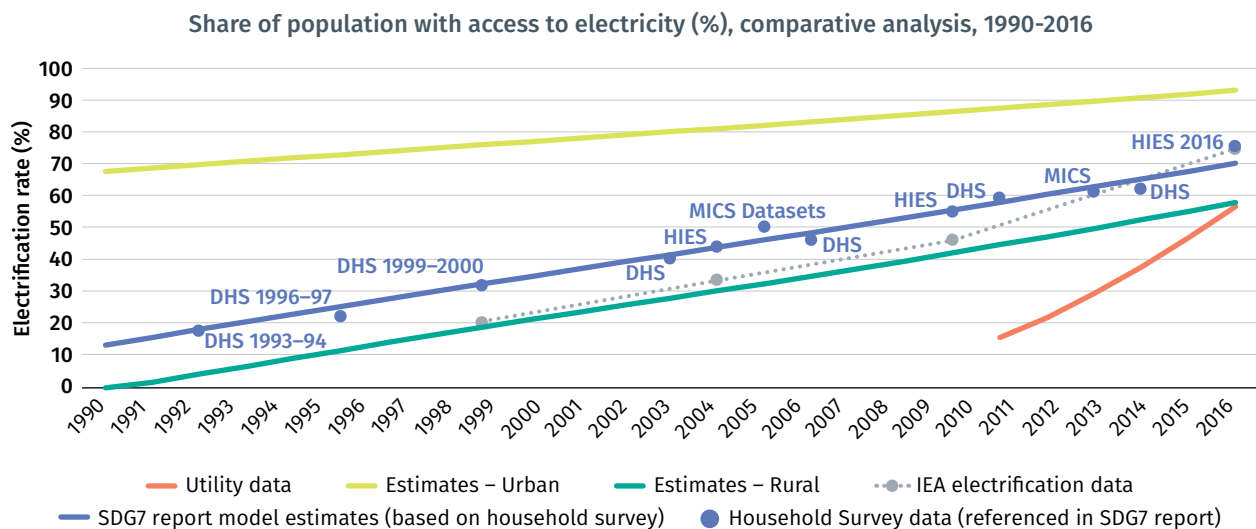
ANNEX 2 • SHEDDING LIGHT ON ELECTRIFICATION DATA: TRENDS AND PATTERNS OF ELECTRIFICATION

For 20 countries with the largest electricity access deficit, we undertook a triangulation exercise to bring together complementary sources of data on electrification so as to improve the understanding of electrification trends. The exercise entailed collection and comparative analysis of government-reported access rates, household survey-reported, utility-reported data, and industry data on solar panel sales and their estimated impact on electrification.

Further, using a range of historic surveys that bring together data on electrification and socioeconomic characteristics, household survey data from these countries were disaggregated to identify patterns of electricity access across different socioeconomic groups—by household consumption quintiles (from poorest to richest) and by gender of the head of household. Because of the limited availability of surveys that support full analysis of household poverty level, our analysis may not be based on the most recent surveys that are used to report on overall electrification trends in this report.

BANGLADESH

Electrification trends



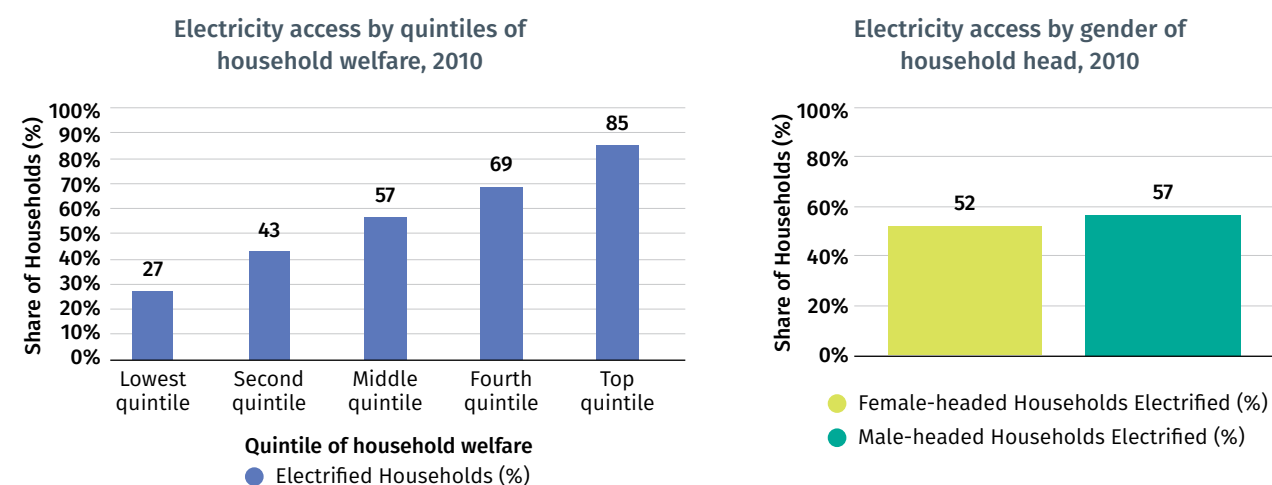
Source: World Bank 2018, Annual reports of Bangladesh Utilities, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
–	No government report available	57.1	Utility – Formal: Aggregated from DESCI, DPDC, REB and WZDPDC annual report, 2016
75.9	Tracking SDG 7 report: based on HIES 2016	–	Utility – Informal
75	World Energy Outlook 2017: based on Power Development Board, 2015 (grid connections) and IDCOL, 2016	11.6	Solar (Tier 1 and above): IDCOL Annual report, 2016

Bangladesh's latest household survey (HIES, 2016) reported that 75.9% of the population has access to electricity, ranging from 94% in urban areas to 69% in rural areas. At the same time, Bangladesh's utilities reported a total of 20.7 million household connections. On the basis of the connections reported and an average household size of 4.5, the grid connection rate is estimated at 57.1%. Grid connections have been rising steeply in recent years, with the Rural Electrification Board adding, on average, 3.5 million new rural connections annually since 2015, with a view to meeting the country's goal of universal access by 2021. The gap of 18.8% between the electrification rate reported by the HIES and the grid connection rate can be partially explained by the rapid development of off-grid solar solutions, mainly through Infrastructure Development Company Limited (IDCOL). According to IDCOL, 11.6% of the population relied on solar home systems, providing service at Tier 1 and above, in 2016. The utility connection rate and the off-grid access rate together account for 68.7% of the total electricity access rate, leaving a gap of 7.2% compared to HIES results. Informal connections and other forms of self-supply like diesel generators or rechargeable batteries could explain the difference. Assuming Bangladesh's average household consumption is 671.3 kWh/year, even an illustrative 1% of nontechnical loss from informal connections would provide access to 0.82% of the population.

Patterns of electrification

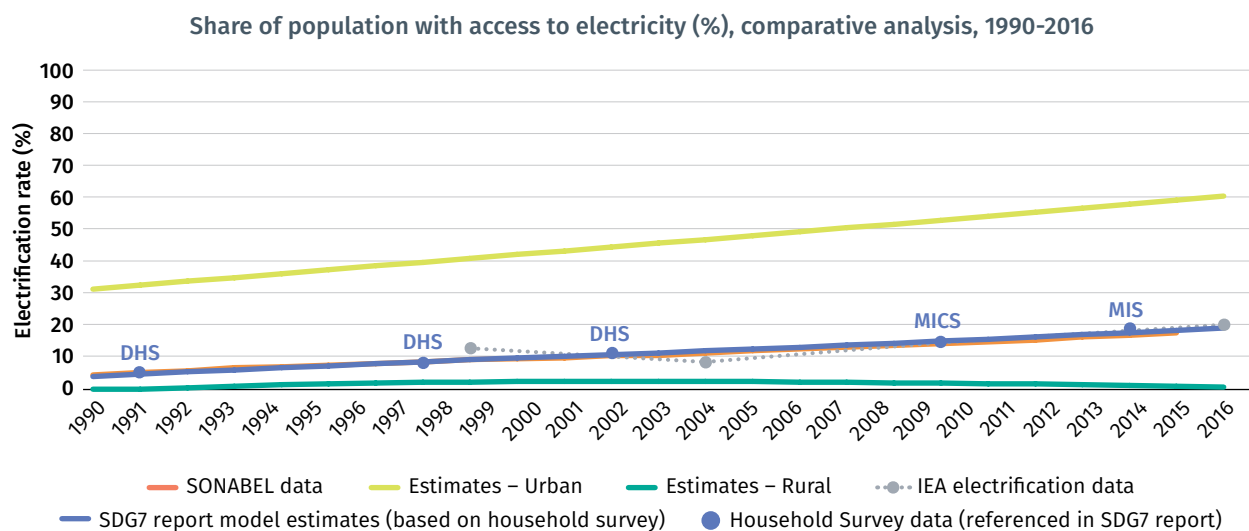
Household survey data can also be disaggregated to identify patterns of electricity access across different socioeconomic groups. In Bangladesh, disaggregating access by consumption quintiles (from poorest to richest) shows a steady increase in electrification as overall household welfare rises. Access rates improve by more than three times from the bottom quintile to the top quintile, rising by about 14 percentage points from one quintile to the next. Compared to other large access deficit countries in developing Asia, where the top quintile has 1.6 times the access rate of the bottom quintile, disparity in access by consumption quintiles is more pronounced in Bangladesh. Gender-disaggregated access rates show that male-headed households have higher levels of access compared to female-headed households by about five percentage points, whereas other large access deficit countries in Asia have gender parity in this respect. Overall, household consumption drives access disparity in Bangladesh to a greater extent than gender.



Source: [GMD] ([SAR]TSD/World Bank – latest year available)

BURKINA FASO

Electrification trends



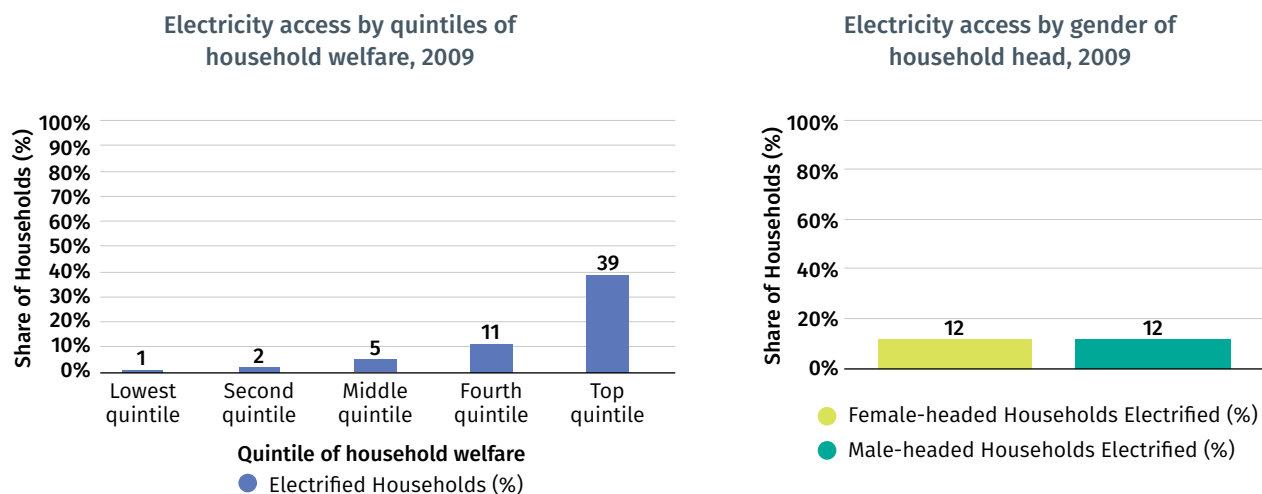
Source: World Bank 2018, SONABEL reports, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
–	No government report available	17.7	Utility – Formal: SONABEL report, 2015
19.2	Tracking SDG 7 report: based on model estimate, 2016	–	Utility – Informal
20.3	World Energy Outlook 2017: based on Ministère de l'Énergie, Burkina Faso, 2015	0.1	Solar (Tier 1 and above): IRENA, 2016

Burkina Faso's latest household survey (MIS, 2014) reported that 19.2% of the population has access to electricity, ranging from 58% in urban areas to 3% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 19.2% by 2016. In parallel, the latest utility report from SONABEL reported 0.55 million of household connections in 2015. On the basis of the connections reported and a household size of 5.9, the grid connection rate is estimated at 17.7%. The gap of two percentage points between electrification rates estimated from household surveys and those attributable to grid electrification by the utility can scarcely be explained by the development of off-grid solar solutions because—according to IRENA—only 0.1% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above services in 2016. Informal connections and other forms of self-supply like diesel generators or rechargeable batteries could potentially explain the remaining gap.

Patterns of electrification

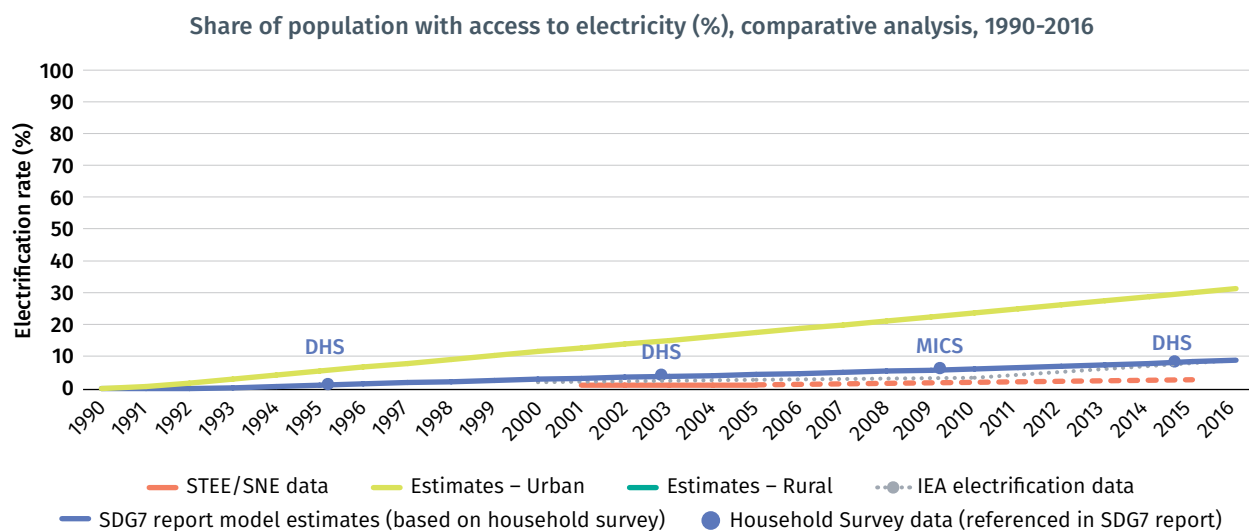
Disaggregated patterns of electricity access across different socioeconomic groups in Burkina Faso show stark differences in access rates across consumption quintiles. There is a striking increase in electrification as overall household welfare rises, with access rates improving by more than 38 times from the bottom quintile to the top quintile. Electricity access is seen to double from one quintile to the next in the bottom three quintiles, and almost quadruples from the fourth quintile to the fifth. Disparity in access across consumption quintiles in Burkina Faso is greater than that of other large access deficit countries in Sub-Saharan Africa, where the access rate of the top quintile is about 6.5 times that of the bottom quintile. Gender-disaggregated access rates show that female-headed households have similar levels of access as male-headed households in Burkina Faso, which is typical of the largest access deficit countries in Sub-Saharan Africa. Overall, household consumption, not gender, drives access disparity in Burkina Faso.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

CHAD

Electrification trends



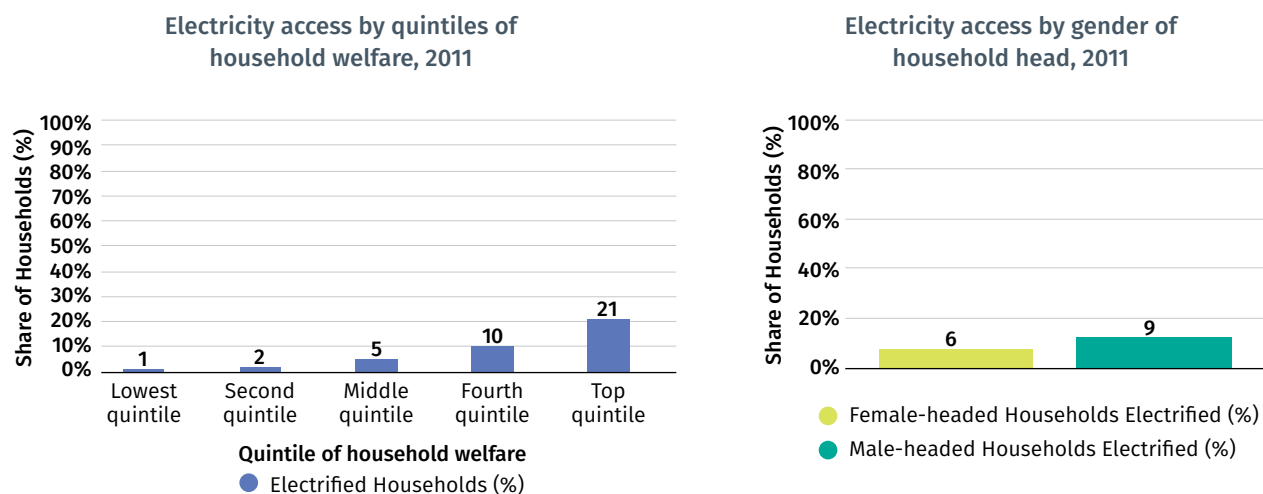
Source: World Bank 2018, SNE, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
6.4	Government report based on Ministry of Energy, 2017	2.8	Utility – Formal: SNE, 2015
8.8	Tracking SDG 7 report: based on model estimate, 2016	3.6	Utility – Informal: SNE, 2016
8.8	World Energy Outlook 2017: based on DHS survey 2014/15	0.01	Solar (Tier 1 and above): IRENA, 2016

Chad's latest household survey (DHS 2014–15) reported that 7.7% of the population has access to electricity, ranging from 32.4% in urban areas to 0.7% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 8.8% by 2016. In parallel, the latest utility report from SNE reported 0.67 million household connections for 2015. On the basis of the connections reported and a household size of 5.8, the formal grid connection rate is estimated at 2.8%. Meanwhile, the utility estimated nontechnical losses at 27%. Assuming Chad's average household consumption is 448 kWh/year, an estimated additional population of 3.6% may be obtaining grid electricity through informal connections. Overall, the (formal and informal) utility connection rate would then account for 6.4% of the population in 2016, leaving a gap of 2.4% compared to household survey's results. Because—according to IRENA—only 0.01% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above services in 2016, the bulk of the difference is likely accounted for by other forms of self-supply like diesel generators or rechargeable batteries.

Patterns of electrification

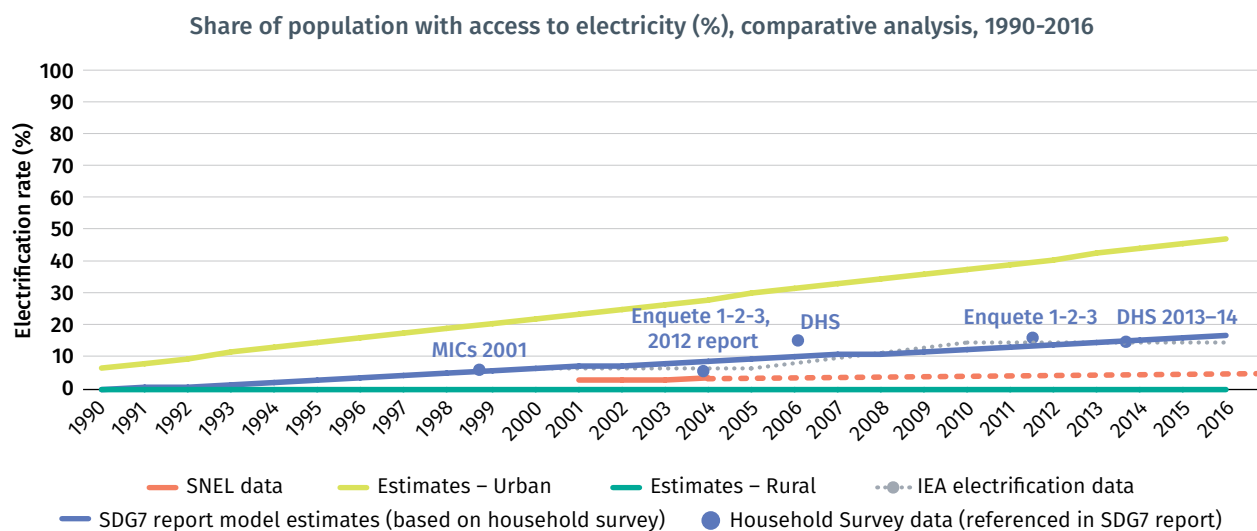
Disaggregating household survey data by consumption quintiles (from poorest to richest) to identify patterns of electricity access in Chad shows significant increase in electrification as overall household welfare rises. Access rates improve by more than 21 times from the bottom quintile to the top quintile, doubling from one quintile to the next. Disparity in access across consumption quintiles is more pronounced in Chad compared to other large access deficit countries in Sub-Saharan Africa. Gender-disaggregated access rates show that male-headed households have higher levels of access compared to female-headed households, and outperform by about three percentage points; which is relatively unusual compared to other large access deficit countries in Sub-Saharan Africa. However, overall, household consumption drives access disparity in Chad to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

CONGO, (DEM, REP, OF)

Electrification trends



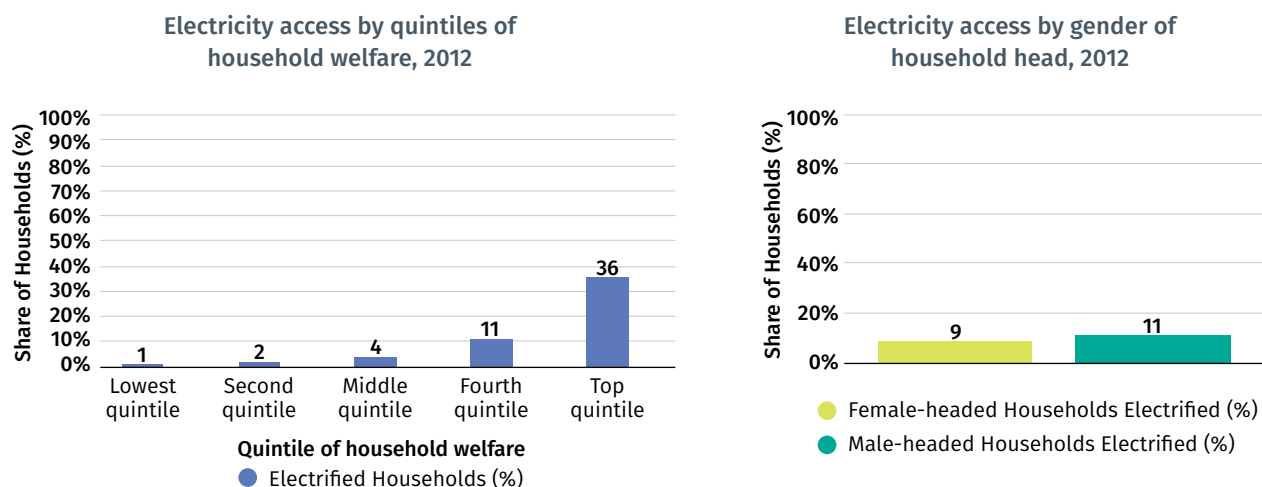
Source: World Bank 2018, SNEL, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
–	No government report available	5.2	Utility – Formal: Societe Nationale d’Electricite – SNEL, 2017
17.1	Tracking SDG 7 report: based on model estimate, 2016	–	Utility – Informal
15.2	World Energy Outlook 2017: based on SNEL, 2016	0	Solar (Tier 1 and above): IRENA, 2016

The latest household survey (DHS 2013–14) in the Democratic Republic of Congo reported that 13.5% of the population has access to electricity, ranging from 42% in urban areas to 0.4% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 17.1% by 2016. The national utility SNEL reported 0.8 million household connections in 2017. On the basis of the connections reported and a household size of 5.3, the formal grid connection rate is estimated at 5.2%, leaving a gap of 11.9% compared to household survey results, which can be explained in a number of ways. First, the utility SNEL has limited capacity to record and track actual grid connections. Second, given DRC’s vast territory, small scale independent operators are also providing service in provincial centers. Third, informal connections and other forms of self-supply like diesel generators or rechargeable batteries could potentially also explain the gap. Assuming an average household consumption of 1304 kWh/year, an illustrative calculation of 1% of nontechnical loss would mean that 0.15% of population had electricity access through informal connections in 2016. According to IRENA’s statistics, there are no reported sales of solar panels capable of providing Tier 1 service or above.

Patterns of electrification

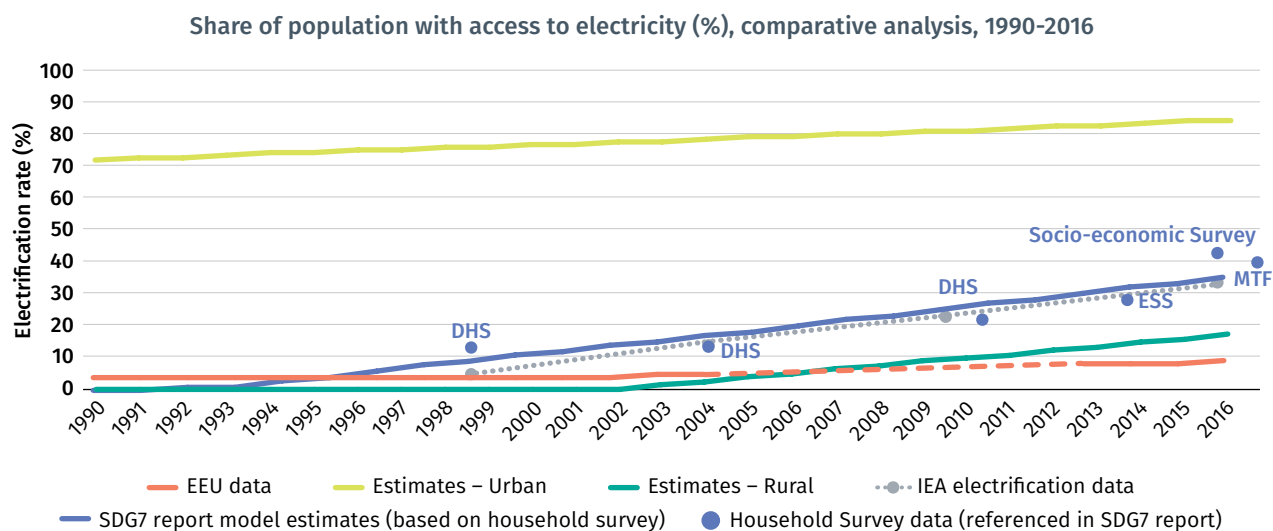
In the Democratic Republic of Congo, disaggregating access by consumption quintiles (from poorest to richest) shows a massive increase in electrification as overall household welfare rises. Access rates improve by more than 60 times from the bottom quintile to the top quintile, a steeper gradient than that found in most other large access deficit countries in Sub-Saharan Africa. Access rates in the lowest quintile barely register, and triple from one quintile to the next. Gender-disaggregated access rates show that male-headed households have higher levels of access compared to female-headed households, and outperform by 1.7 percentage points. Overall, household consumption drives access disparity in the Democratic Republic of Congo to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

ETHIOPIA

Electrification trends



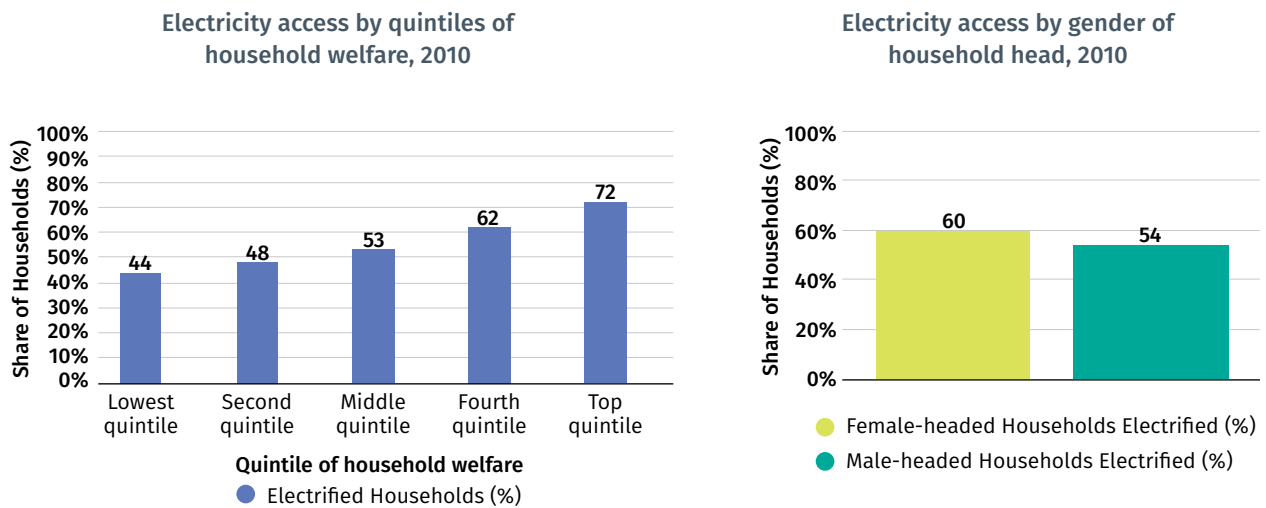
Source: World Bank 2018, EEU, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
33	Government Report: National Electrification Program, 2017	10.5	Utility – Formal: estimated by Ethiopian Electric Utility - EEU, 2017
		0.5	Utility – Informal: estimated by EEU, 2017
42	Tracking SDG 7 report: based on MTF, 2017	29	Utility - Total: MTF (tier 1 and above), 2017
33	World Energy Outlook 2017: based on National Electrification Program, Implementation Road Map and Financing Prospectus, 2017	13	Solar: MTF (tier 1 above), 2017

Ethiopia's latest household survey (MTF, 2017) reported that 42% of the population has access to electricity above Tier 1, ranging from 96.5% in urban areas to 27.7% in rural areas. In parallel, the utility EEU reported 2.4 million household connections in 2017. On the basis of the connections reported and a household size of 4.6, the formal grid connection rate is estimated at 10.5%. Furthermore, the utility estimated nontechnical losses of 1.2% representing informal connections to the grid. Assuming Ethiopia's average household consumption is 444 kWh/year, an estimated additional 0.5% of the population may be obtaining grid electricity through such informal connections. However, the MTF survey reported a much higher rate of grid connection for 2017, at 29%. The gap between grid access rates from the utility and from the MTF survey can be explained by the fact that in Ethiopia—because of relatively high connection charges—many households share a single metered connection and divide the utility bill among themselves (Kojima and Trimble 2016). This phenomenon is captured by MTF and results in a much higher grid connection rate of 29.0%. According to MTF, the difference between the utility connection rate of 29.0% and the overall access rate of 42.0% is explained by the fact that 13% of the population relies on solar home systems and solar lighting systems that provide service at Tiers 1 and 2.

Patterns of electrification

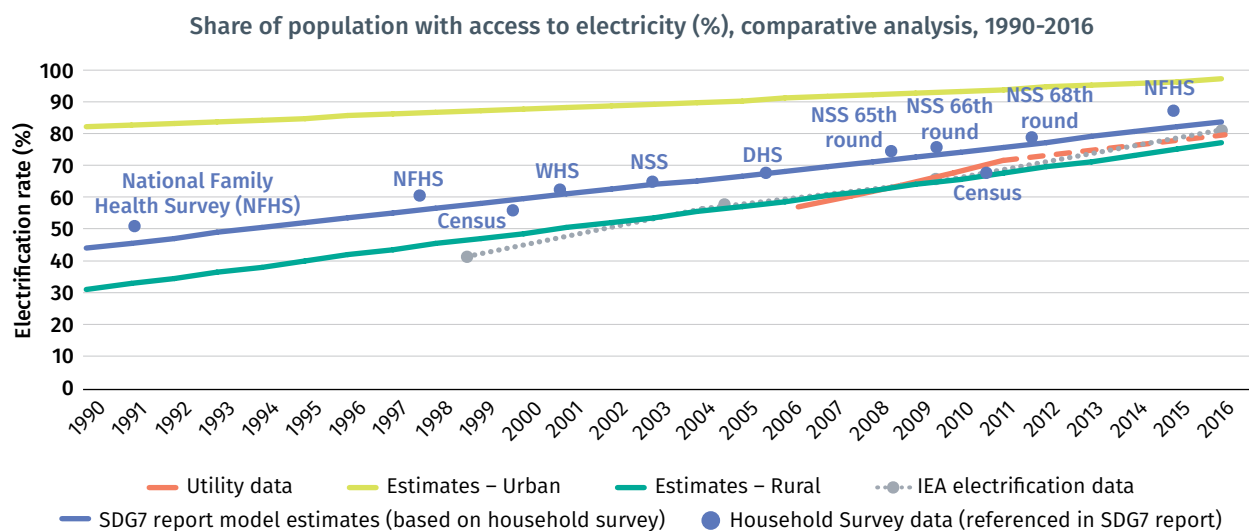
In Ethiopia, disaggregating access by consumption quintiles (from poorest to richest) shows a steady increase in electrification as overall household welfare rises, although the disparity between rich and poor is smaller than what is found in the largest access deficit countries of Sub-Saharan African. Access rates improve by close to 40% from the bottom quintile to the top quintile, rising by 5 percentage points in the bottom three quintiles, and 10 percentage points in the top two quintiles. Gender-disaggregated access rates reveal a notable characteristic: female-headed households have higher levels of access when compared to male-headed households, and outperform by about 6.5 percentage points. Overall, household consumption drives access disparity in Ethiopia to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

INDIA

Electrification trends



Source: World Bank 2018, Saubhagya Dashboard, WEO 2017, World Bank WDI

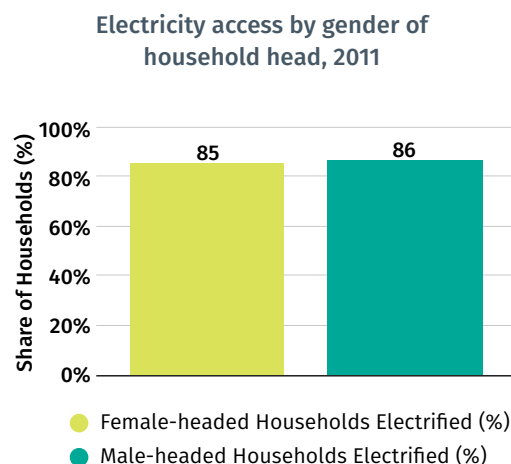
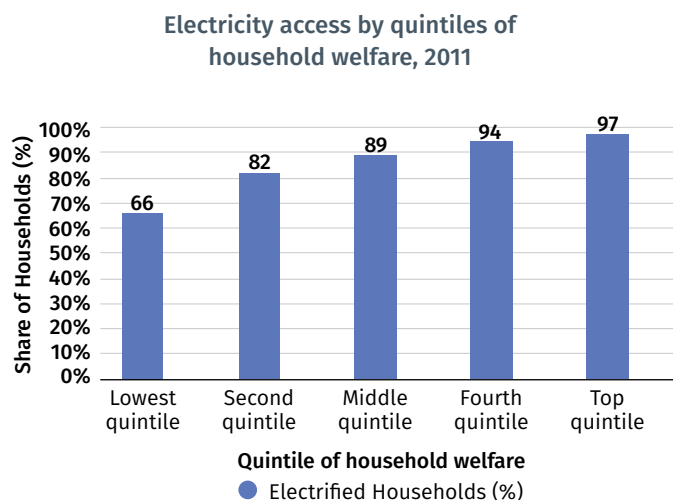
Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
80.3	Government report: Saubhagya Dashboard, Oct. 2017	80.3	Utility – Formal: Saubhagya Dashboard, Oct. 2017
		–	Utility – Informal
84.5	Tracking SDG 7 report: based on model estimate, 2016	0.4	Solar (home lighting systems): MNRE, 2015-2016
82	World Energy Outlook 2017: Urban: based on Power for All agreements for states; Rural: GARV (31 Dec 2016). Includes population with access to SHS (around 1 million)	0.25	Solar (Tier1 and above): IRENA, 2016

The rapid growth of electricity access in India is propelled by the country's \$2.5 billion electrification program to reach universal electrification by December 2018. India's latest household survey (NFHS, 2015) reported that 88% of its population has access to electricity, ranging from 97.5% in urban areas to 83.2% in rural areas. Model estimates, based on the full series of historical progress, suggest the access rate should have reached about 84.5% for 2016. In parallel, the utilities combined reported 145.1 million of household connections in 2017. On the basis of the connections reported and a household size of 4.8, the formal grid connection rate is estimated at 80.3%. The gap in electrification rates reported by household surveys, and those attributable to grid electrification by the utility, may be due to a number of factors. First, there are no official statistics on nontechnical losses, so the exact extent of informality is unknown. An illustrative calculation simulating the impact of 1% nontechnical losses, on the basis of India's average household consumption of 1144 kWh/year, suggest that this level of losses could provide informal access to 1.05% of population. Second, households in rural areas can use a variety of non-grid-based solutions, including solar electricity, diesel generation, or rechargeable batteries. Of these options, solar electricity is the only one for which official statistics are available from two sources, both of which give

quite consistent results. First, India’s Ministry of New and Renewable Energy reported 1.29 million solar home lighting systems in 2016, which translates to 0.4% of population. Second, according to IRENA’s global database, 0.25% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016.

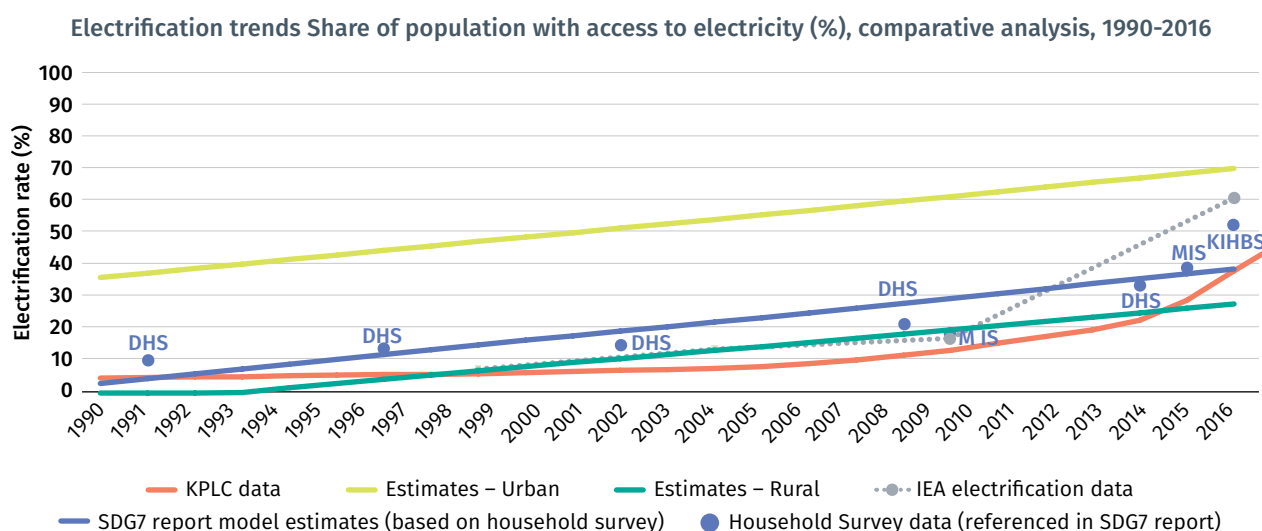
Patterns of electrification

Disaggregated household survey data by consumption quintiles (from poorest to richest) in India shows a steady improvement in access rates as overall household welfare rises. The access rate of the top quintile is 1.5 times that of the bottom quintile, in line with the average for the largest access deficit countries in Asia. Access rates are seen to increase by 16 percentage points from the bottom quintile to the second quintile and by about 5 percentage points after that. Gender-disaggregated access rates show that female-headed households have similar levels of access when compared to male-headed households, which is also typical of the largest access deficit countries in Asia. Overall, household consumption, not gender, drives access disparity in India.



Source: [GMD] ([SAR]TSD/World Bank – latest year available)

KENYA



Source: World Bank 2018, KPLC, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
70.3	Government Report: based on KPLC Annual report, 2016-2017 ¹	40.4	Utility – Formal: Kenya Power (KPLC Annual Report, 2016)
		–	Utility – Informal
56	Tracking SDG 7 report: based on KIHBS 2015-2016	41.4	Utility - Total: KIHBS 2015-2016
64.5	World Energy Outlook 2017: based on Grid connections reported by Kenya Power, 2016. Includes 2% access rate from SHS based on sales	1.6	Solar (Tier1 and above): IRENA, 2016
		14.1	Solar: KIHBS 2015-2016

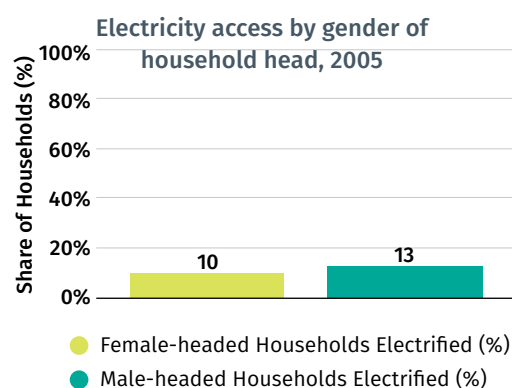
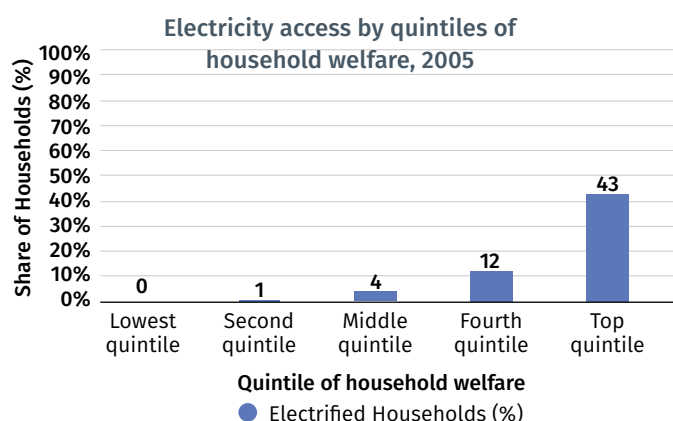
Kenya's latest household survey (KIHBS, 2015-16) reported that 56% of its population has access to electricity, ranging from 78% in urban areas to 16% in rural areas. Model estimates, based on the full series of historical progress, suggest that the access rate should have reached around 35.4% for 2016. In parallel, the utility KPLC reported 4.9 million of household connections in 2016. Based on the connections reported and a household size of 4, the formal grid connection rate is estimated at 40.4%. There are no official statistics on non-technical losses that reflect the presence of informal connections. An illustrative simulation of 1% nontechnical losses, given Kenya's average household consumption of 539 KWh/year, could potentially provide informal access to 0.55% of the population. The grid connection rate from the utility is aligned with the findings from the latest household survey, which reported that 41.4% of the population obtain electricity through grid connections. The gap in electrification rates reported by household surveys, and those attributable to grid electrification by the utility, can be partially explained by the use of a variety of off-grid solutions, including diesel generators, rechargeable batteries and solar systems. Statistics are only available regarding penetration of solar systems. According to

¹ The government reported electrification rate is based on the 6.06 million utility connections as of September 30th, 2017. These numbers are converted into an access rate using a household size of 5.5 and a population estimate of 46.9 million. These diverge from the household size of 3.6 reported in the most recent DHS survey, and the population of 49.7 million in the World Development Indicators. These differences account for the divergence in the overall electrification rate.

the household survey, 14.1% of the population relied on off-grid solar power, and IRENA reported 1.6% of the population of Kenya relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016..

Patterns of electrification

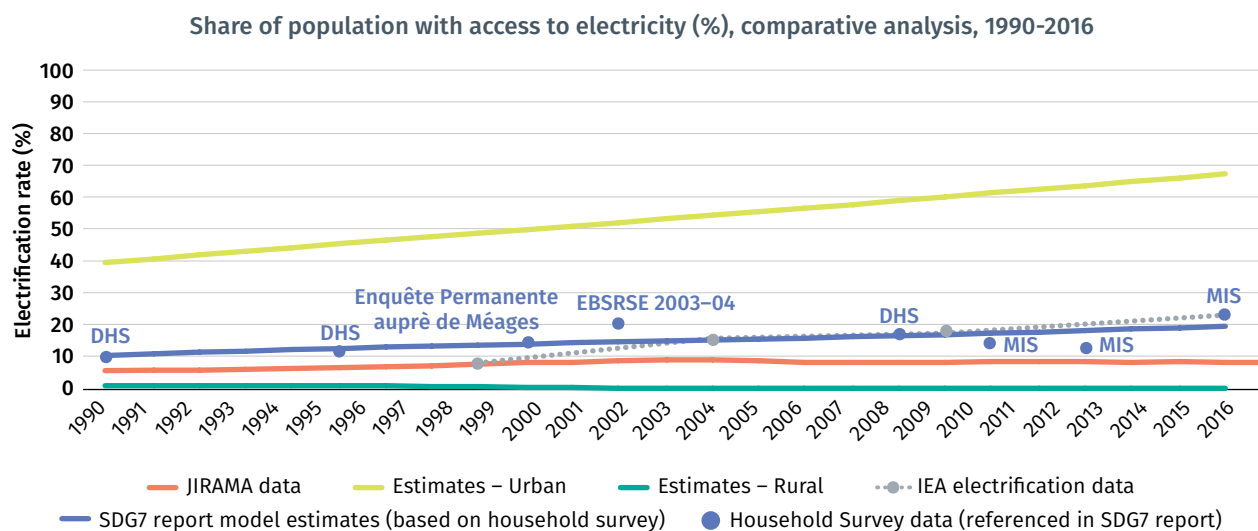
Using household survey data to identify patterns of electricity access across different socio-economic groups in Kenya shows that there is substantial increase in access rates as overall household welfare rises. Access rates in the top quintile is 40 percentage points higher than that in the bottom quintile, with over 30 percentage point jump from the fourth quintile to the fifth. The disparity in the top quintiles that is seen in Kenya is more pronounced than the average for the largest access deficit countries in Sub-Saharan Africa. Gender-disaggregated access show that male-headed households have higher levels of access when compared to female-headed households, and outperform by two percentage points, departing from the gender parity in access seen in other large access deficit countries in Sub-Saharan Africa. Overall, household consumption drives access disparity in Kenya to a farther extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

MADAGASCAR

Electrification trends



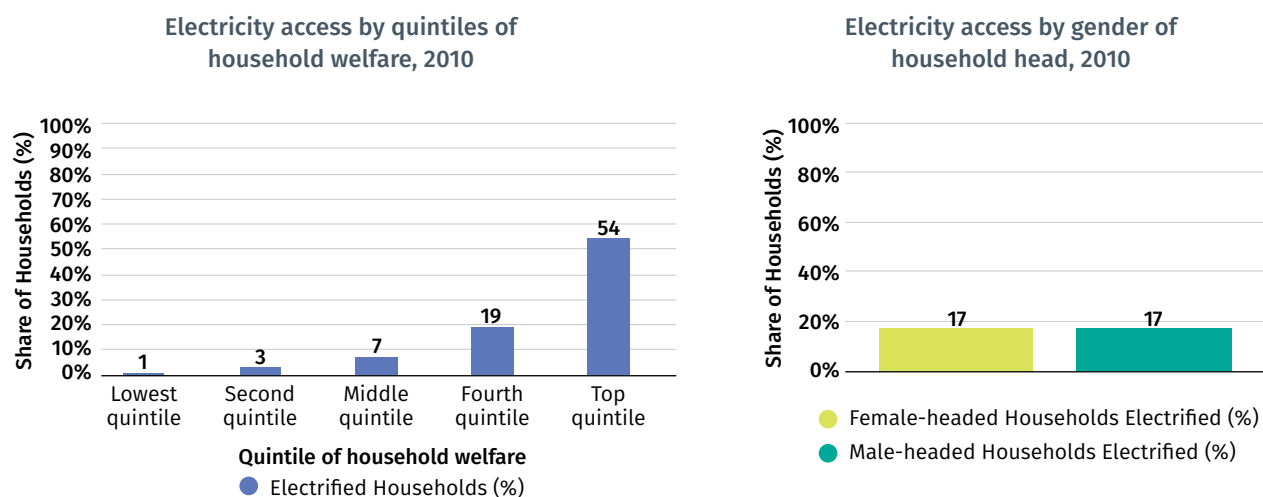
Source: World Bank 2018, JIRAMA, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
15	Government Report: based on National Electrification Strategy, Energy Ministry, 2014	8.2	Utility – JIRAMA, 2016
22.9	Tracking SDG 7 report: based on MTF, 2017	–	Utility – Informal
22.9	World Energy Outlook 2017: based on National Electrification Program, Implementation Road Map and Financing Prospectus, 2017	0.03	Solar (Tier 1 and above): IRENA, 2016

Madagascar's latest household survey (MIS, 2016) reported that 22.9% of the population has access to electricity, ranging from 67.3% in urban areas to 17.3% in rural areas. In parallel, the utility JIRAMA reported 0.5 million household connections in 2016. On the basis of the connections and a household size of 4.2, the formal grid connection rate is estimated at 8.2%. The substantial gap in electrification rates reported by household surveys, and those attributable to grid electrification by the utility, could be due to a variety of causes, including informal connections to the utility as well as off-grid supply from diesel generators, rechargeable batteries, or solar systems. Available data from IRENA suggest that the penetration of solar is negligible, with only 0.03% of the population relying on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 access and above in 2016. A more comprehensive off-grid market analysis is being conducted nationally and results are expected in Spring 2018.

Patterns of electrification

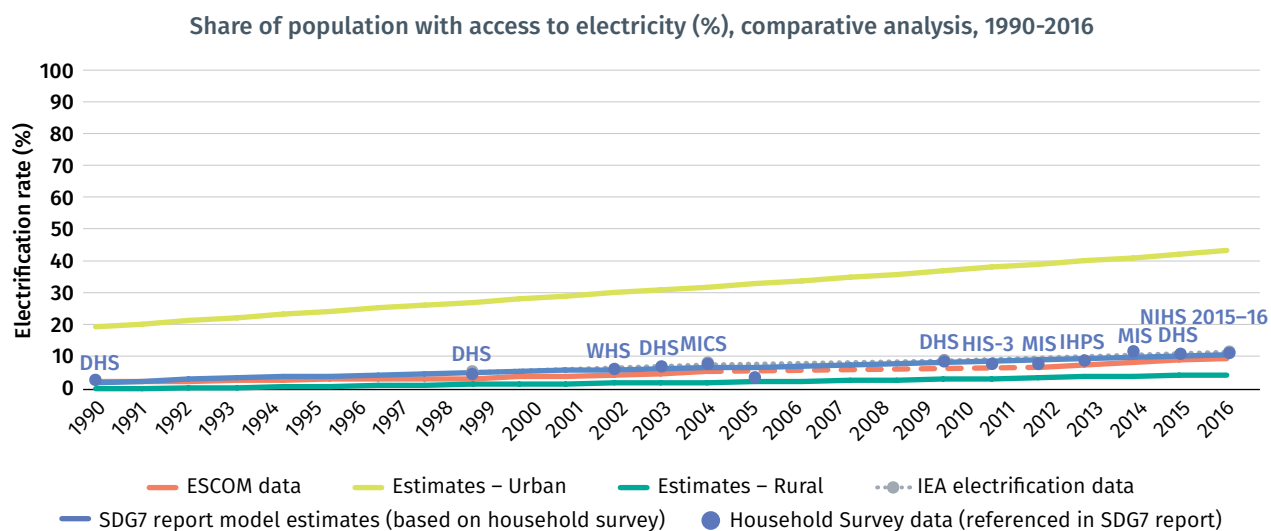
Household survey data can also be disaggregated to identify patterns of electricity access across different socioeconomic groups. In Madagascar, disaggregating access by consumption quintiles (from poorest to richest) shows a striking increase in access rates as overall household welfare rises. The access rate of the top quintile is 52 percentage points higher than that of the bottom quintile (the average difference between top and bottom quintiles for the largest access deficit countries in Sub-Saharan Africa is 37 percentage points), and doubles from one quintile to the next in the bottom three quintiles, and triples in the next two quintiles. Gender-disaggregated access rates show that male-headed households have similar levels of access as female-headed households. Overall, household consumption, not gender, drives access disparity in Madagascar.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

MALAWI

Electrification trends



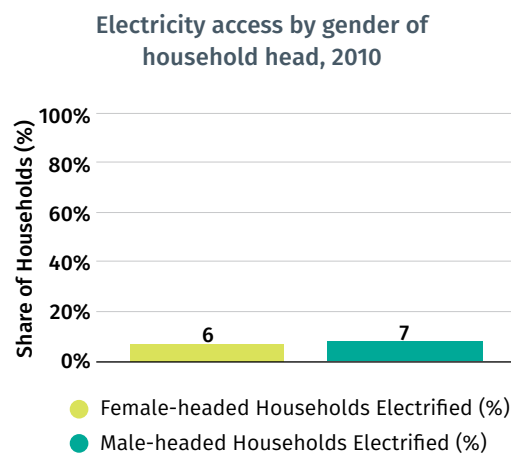
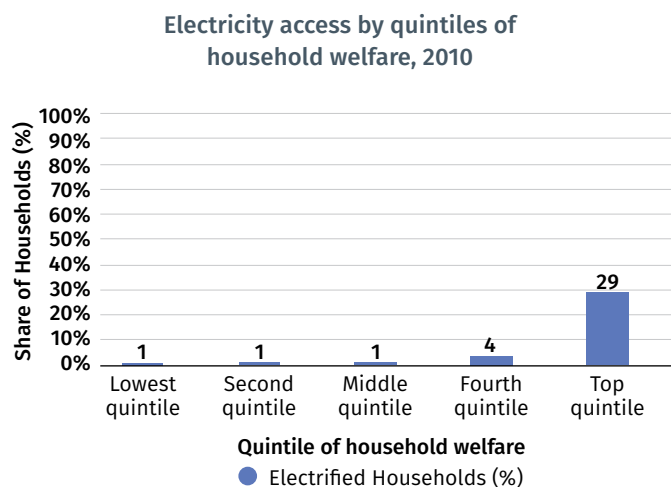
Source: World Bank 2018, ESCOM, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
-	No government report available	9.3	Utility – Formal: ESCOM, 2016
11	Tracking SDG 7 report: based on DHS 2015-16	-	Utility – Informal
11.3	World Energy Outlook 2017: based on DHS survey, 2016 with off-grid estimates	0	Solar (Tier 1 and above): IRENA, 2016

Malawi's latest household survey (DHS, 2015–16) reported that 11% of the population has access to electricity, ranging from 42% in urban areas to 4% in rural areas. In parallel, the utility ESCOM reported 0.37 million household connections in 2016. On the basis of the connections and a household size of 4.5, the formal grid connection rate is estimated at 9.3%. There are no official data on nontechnical losses to gauge the extent of informal connections. An illustrative simulation of 1% nontechnical losses, given Malawi's average household consumption is 1224 kWh/year, could potentially provide informal access to 0.27% of the population in 2016. The relatively small gap between the utility connection rate and the access recorded by the household survey could be attributable to off-grid solutions, such as diesel generators and rechargeable batteries. According to IRENA, none of the population relied on solar home systems, solar mini-grids, or solar lighting systems capable of providing Tier 1 and above service in 2016.

Patterns of electrification

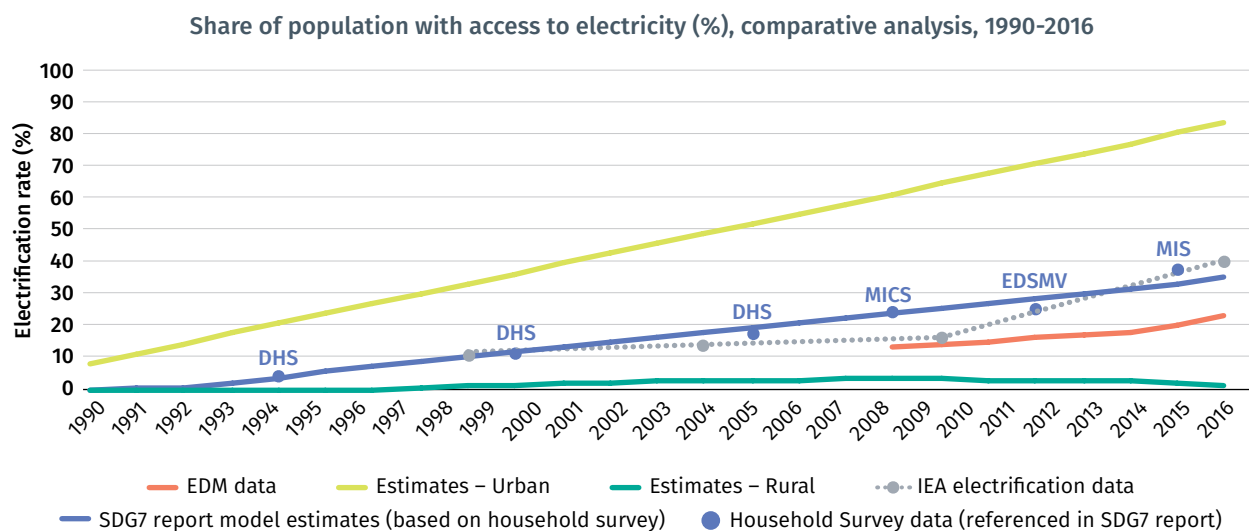
Disaggregated household survey data reveal patterns of electricity access across different socioeconomic groups in Malawi. Access by consumption quintiles (from poorest to richest) shows material increase in access rates as overall household welfare rises. The access rate of the top quintile is 28 percentage points higher than that of the bottom quintile, and 23 percentage points higher than the fourth quintile, with only marginal improvements in access rates from one quintile to the next in the bottom four quintiles, and a massive sevenfold jump in access rates between quintiles four and five. Gender-disaggregated access rates show that male-headed households have higher levels of access compared to female-headed households by 1.3 percentage points. Overall, household consumption drives access disparity in Malawi to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

MALI

Electrification trends



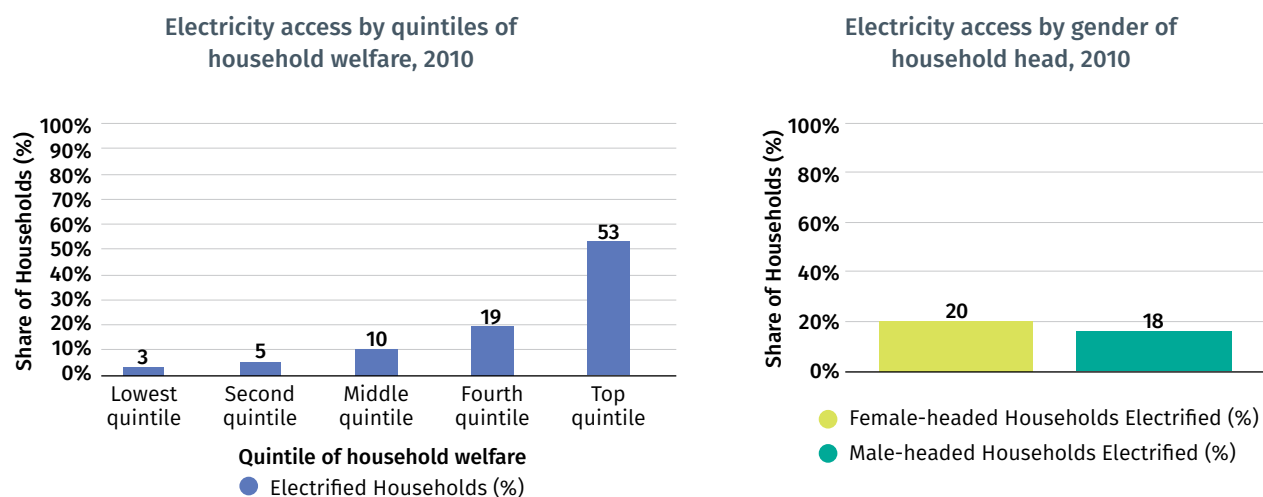
Source: World Bank 2018, EDM, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
39	Government Report: based on SPC indicator statistic, 2016	23	Utility – Formal: Electricite Du Mali - EDM, 2016
35.1	Tracking SDG 7 report: based on model estimate, 2016	–	Utility – Informal
40.5	World Energy Outlook 2017: based on MIS 2015	0.6	Solar (Tier 1 and above): IRENA, 2016

Mali's latest household survey (MIS, 2015) reported that 37.6% of the population has access to electricity, ranging from 83.1% in urban areas to 23.4% in rural areas. Model estimates, based on the full series of historical progress, suggest the access rate should have reached about 35.1% for 2016. In parallel, the utility EDM reported 0.46 million household connections in 2016. On the basis of the connections and a household size of 9, the formal grid connection rate is estimated at 23%. The substantial gap between electrification rates reported by household surveys and those attributable to grid electrification by the utility could have various causes, including informal connections to the utility, as well as off-grid supply from diesel generators, rechargeable batteries, or solar systems. According to IRENA, only 0.6% of the population relied on solar home systems, solar mini-grids, or solar lighting systems capable of providing Tier 1 and above service in 2016.

Patterns of electrification

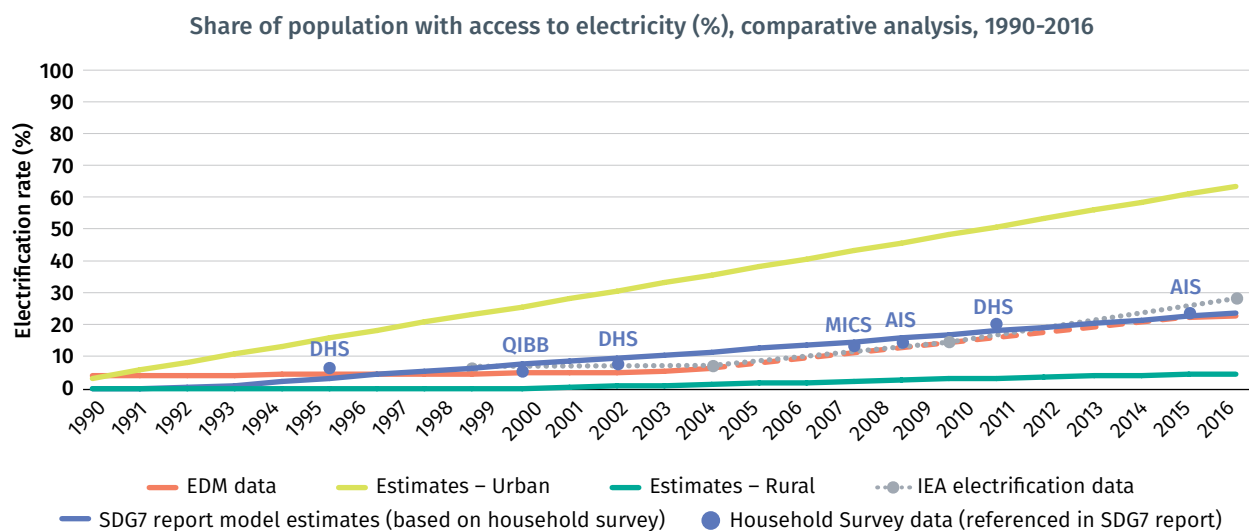
Patterns of electricity access across different socioeconomic groups in Mali that can be extracted from household survey data show a material increase in access rates as overall household welfare rises. The access rate of the top quintile is 50 percentage points higher than that of the bottom quintile, and 33 percentage points higher than the fourth quintile, with only marginal improvements in access rates from one quintile to the next in the bottom four quintiles, and a jump in access rates of over 2.5 times between quintiles four and five. Gender-disaggregated access rates show that female-headed households have higher levels of access compared to male-headed households by 1.7 percentage points. Overall, household consumption drives access disparity in Mali to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

MOZAMBIQUE

Electrification trends



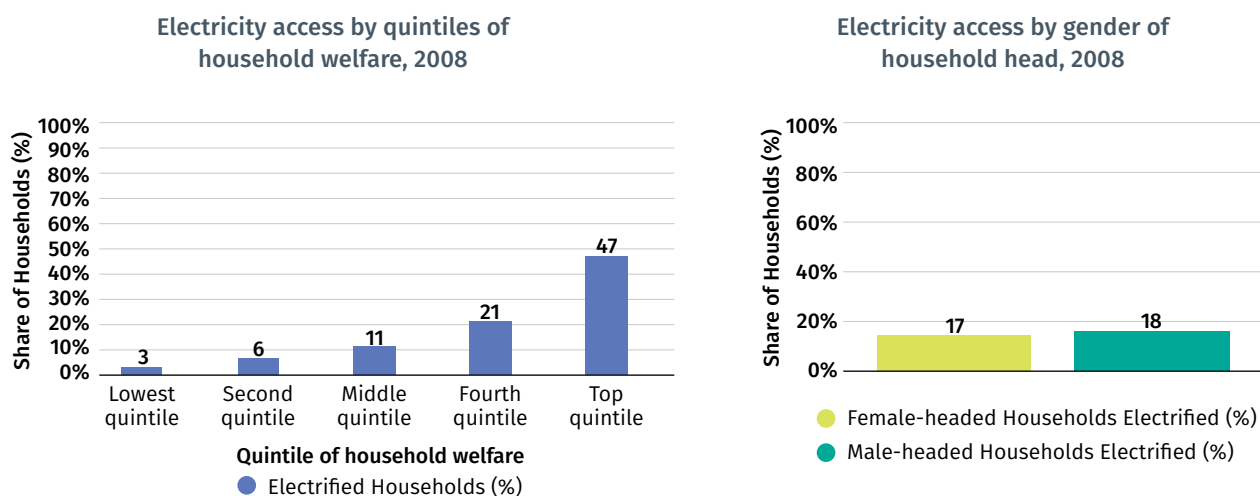
Source: World Bank 2018, EDM, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
25.8	Government Report; based on Electricidade de Moçambique (EDM) statistics, 2016	23.1	Utility – Formal: EDM, 2016
24.2	Tracking SDG 7 report: based on model estimate, 2016	-	Utility – Informal
28.6	World Energy Outlook 2017: based on Directorate of Studies and Planning, Ministry of Energy based on grid connections and off-grid access, 2016	1.5	Solar (Tier 1 and above): IRENA, 2016

Mozambique's latest household survey (AIS, 2015) reported that 24% of the population has access to electricity, ranging from 68% in urban areas to 5% in rural areas. Model estimates, based on the full series of historical progress, suggest that the access rate should have reached about 24.2% for 2016. In parallel, the utility EDM reported 1.51 million household connections in 2016. On the basis of the connections and a household size of 4.4, the formal grid connection rate is estimated at 23.1%. The utility does not report nontechnical losses from which the extent of informal connections could be gauged. An illustrative simulation based on 1% nontechnical losses indicates that, with average household consumption of 1224 kWh/year, informal connections would only supply about 0.03% of the population in 2016. The substantial gap between electrification rates reported by household surveys and those attributable to grid electrification by the utility could be explained by off-grid solutions such as diesel generators, rechargeable batteries, and solar systems. According to household surveys (IOF, 2014/15), 1.5% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2015. In addition, 2.1% of population relied on rechargeable batteries (below Tier 1) in 2015.

Patterns of electrification

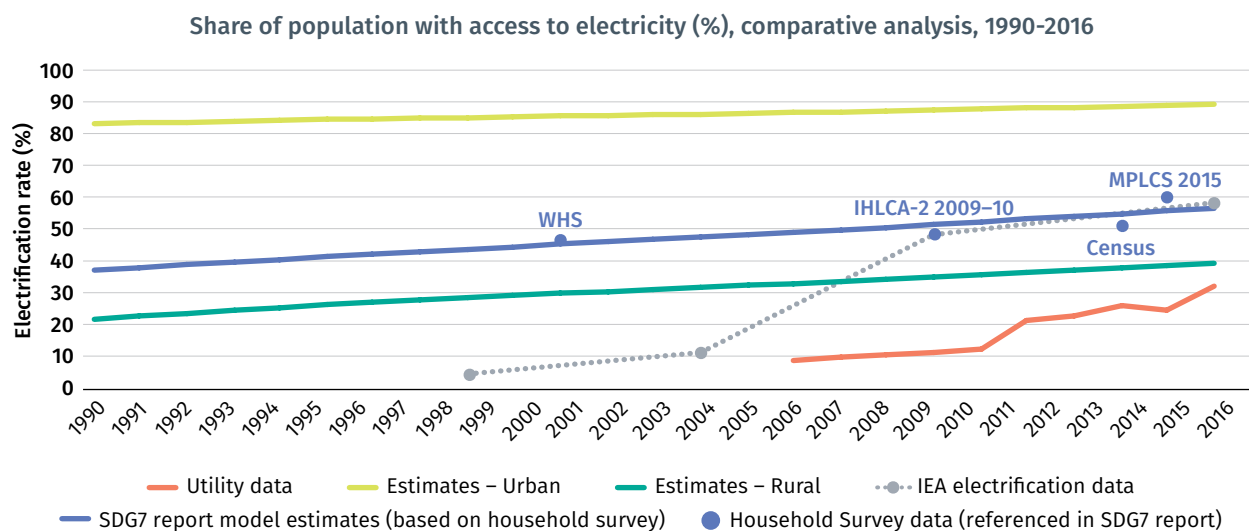
Patterns of electricity access across different socioeconomic groups through disaggregated household survey data shows a striking increase in access rates as overall household welfare rises. The access rate of the top quintile is 13 times that of the bottom quintile (the average for the largest access deficit countries in Sub-Saharan Africa is a jump of 6.5 times from the bottom quintile to the top quintile), and doubles from one quintile to the next. Notably, gender-disaggregated access rates show that male-headed households have higher levels of access compared to female-headed households by 1 percentage point. Overall, household consumption drives access disparity in Mozambique to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

MYANMAR

Electrification trends



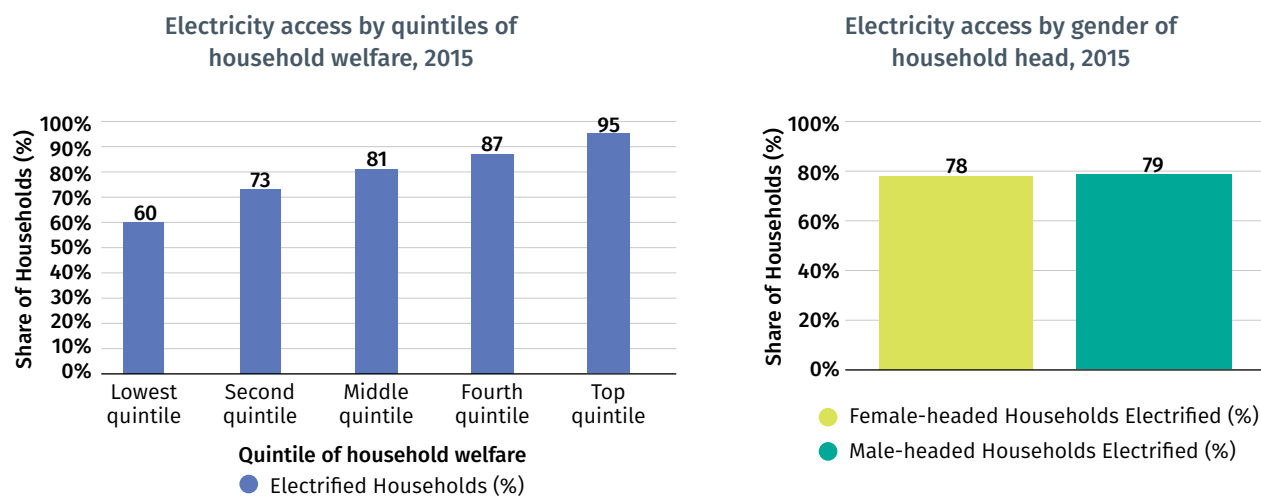
Source: World Bank 2018, Utility Statistics book, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
-	No government report available	32.6	Utility – Formal: Utility Statistic book, 20016 (not public)
		-	Utility – Informal
57	Tracking SDG 7 report: based on model estimate, 2016	17.4	Solar (Solar home systems): MPLCS 2015
58.8	World Energy Outlook 2017: based on DHS 2015-2016, includes off-grid estimates	10.6	Mini-grids: MPLCS 2015

Myanmar's latest household survey (MPLC, 2015) reported that 60.5% of the population has access to electricity, ranging from 90.8% in urban areas to 48.9% in rural areas. Model estimates, based on historical progress, suggest that the access rate should have reached about 57% by 2016. In parallel, all utilities combined reported 3.1 million connections in 2016. On the basis of the connections and a household size of 5, the formal grid connection rate is estimated at 32.6%. The substantial gap between electrification rates reported by household surveys and those attributable to grid electrification by the utility can be partially explained by the rapid development of off-grid solutions. According to the household survey (MPLC, 2015), 28% of the population relied on solar home systems and mini-grids. Overall, the utility connection rate and the off-grid access rate together reported 60.6% of total electricity access, which aligns with household survey's results.

Patterns of electrification

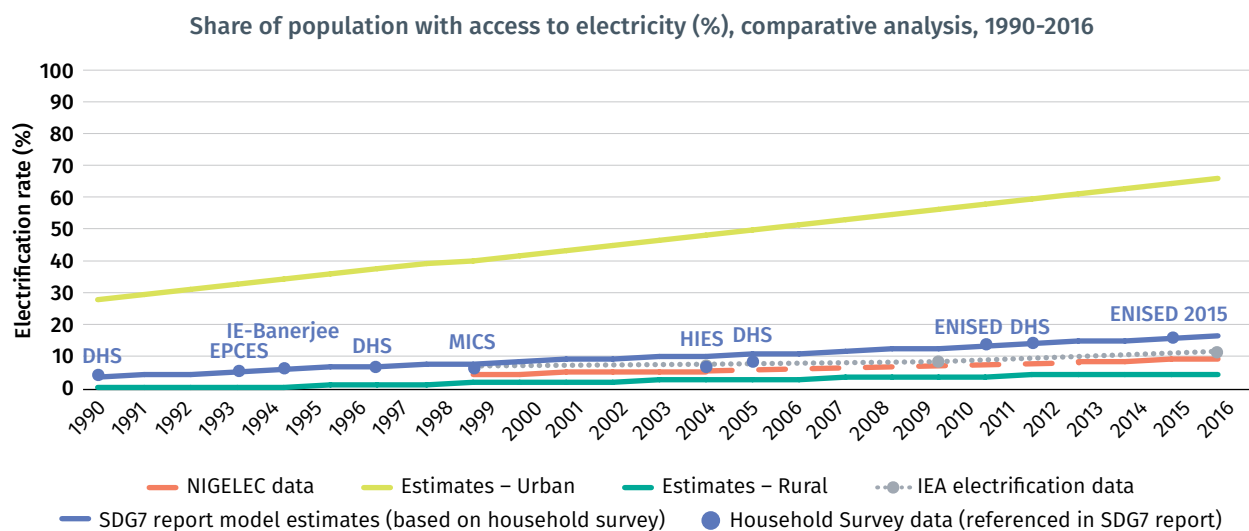
Household survey data can also be disaggregated to identify patterns of electricity access across different socioeconomic groups. In Myanmar, disaggregating access by consumption quintiles (from poorest to richest) shows a steady improvement in access rates as overall household welfare rises. The access rate of the top quintile is 1.6 times that of the bottom quintile, and the access rates of the middle three quintiles differ by about 7 percentage points. The disparity in access rates across consumption quintiles is less pronounced in Myanmar and in line with the average for the largest access deficit Asian countries. Gender-disaggregated access rates show that access rates for male-headed households are marginally higher compared to female-headed households by 1.5 percentage points, which is a departure from the gender parity in access rates seen in the largest access deficit countries in Asia.



Source: [GMD] ([EAP]TSD/World Bank – latest year available)

NIGER

Electrification trends



Source: World Bank 2018, NIGELEC, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
11.7	Government Report: based on Ministère de l'Énergie, République du Niger, 2016	9.2	Utility – Formal: NIGELEC, 2016
16.2	Tracking SDG 7 report: based on model estimate, 2016	-	Utility – Informal
11.2	World Energy Outlook 2017: based on Ministère de l'Énergie, Direction de l'Électricité Nucléaire, 2016	0.003	Solar (Tier 1 and above): IRENA, 2016

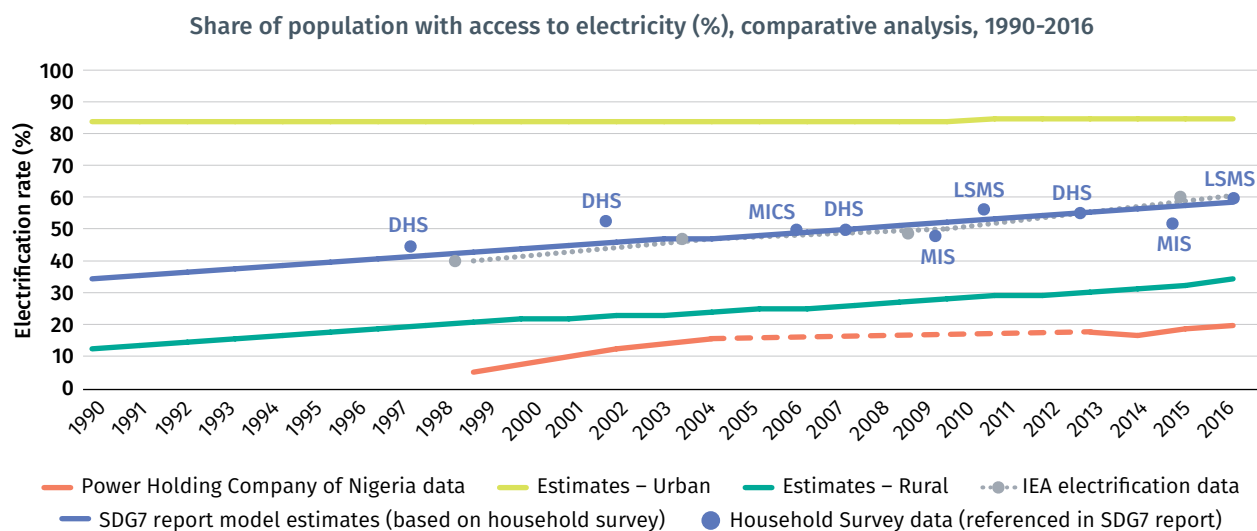
Niger's latest household survey (ENISED, 2015) reported that 16.6% of the population has access to electricity, ranging from 60.2% in urban areas to 7.1% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 16.2% by 2016. In parallel, the utility NIGELEC reported 0.32 million household connections in 2016. On the basis of the connections and a household size of 5.9, the formal grid connection rate is estimated at 9.21%. There are no official statistics for nontechnical losses from which the extent of informal connections could be gauged. An illustrative simulation based on 1% nontechnical losses and average household consumption of 1,210 kWh/year in 2016 suggests that this could provide informal access to 0.19% of the population. The substantial gap between electrification rates reported by household surveys and those attributable to grid electrification by the utility can be explained by reliance on off-grid solutions, such as diesel generators, rechargeable batteries, and solar systems. However, according to IRENA, the penetration of solar electricity in Niger is negligible with only 0.003% of the population relying on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016.

Patterns of electrification

Disaggregated household survey data is not available for Niger within the Global Poverty Working Group Database (GPWG-DB), World Bank.

NIGERIA

Electrification trends



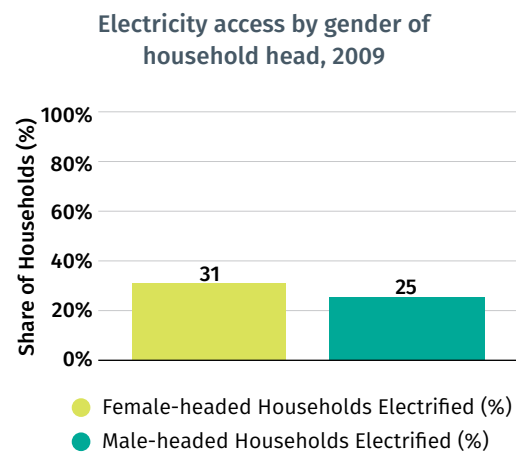
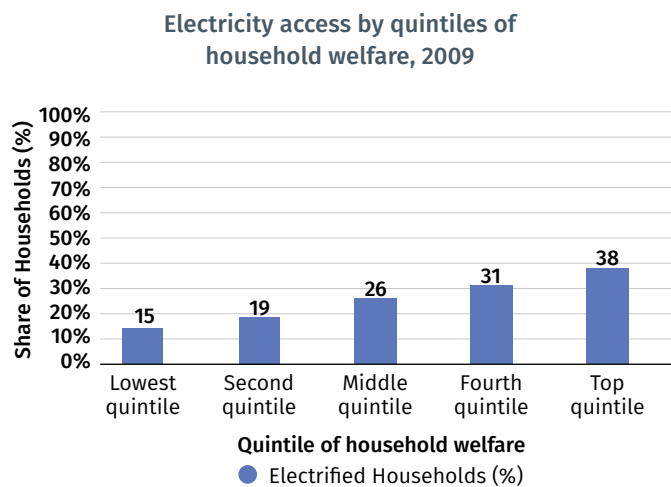
Source: World Bank 2018, NERC, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
–	No government report available	19.4	Utility – Formal: KPI data collected by NERC, 2016
		7.1	Utility – Informal: KPI data collected by NERC, 2016
59.3	Tracking SDG 7 report: based on LSMS, 2016	0.1	Solar (Tier 1 and above): IRENA, 2016
60.6	World Energy Outlook 2017: based on GHS Panel Survey Report, 2015	5.2	Self-generation: LSMS, 2016

Nigeria's latest household survey (LSMS, 2016) reported that 59.3% of the population has access to electricity, ranging from 86% in urban areas to 41.1% in rural areas. In parallel, the aggregated connections across all distribution utilities amounted to 7.7 million household connections in 2017. On the basis of the connections and a household size of 4.9, the formal grid connection rate is estimated at 19.4%. The government also reported an estimated 11.1% of nontechnical losses relating to informal connections. Assuming Nigeria's average household consumption is 740.6 kWh/year, it is estimated that an additional 7.1% of population may be obtaining grid electricity through informal connections. Even considering both formal and informal connections together at 26.5%, there remains a substantial gap with the electrification rates reported by household surveys at 59.3%. This is attributable to a variety of factors, including self-supply through diesel generation, which according to the household survey provides access to a further 5.2% of the population. However, off-grid solar systems do not appear to provide much of an explanation for this divergence, since according to IRENA, only 0.1% of the population relied on solar home systems, solar mini-grids, and solar lighting systems in 2016.

Patterns of electrification

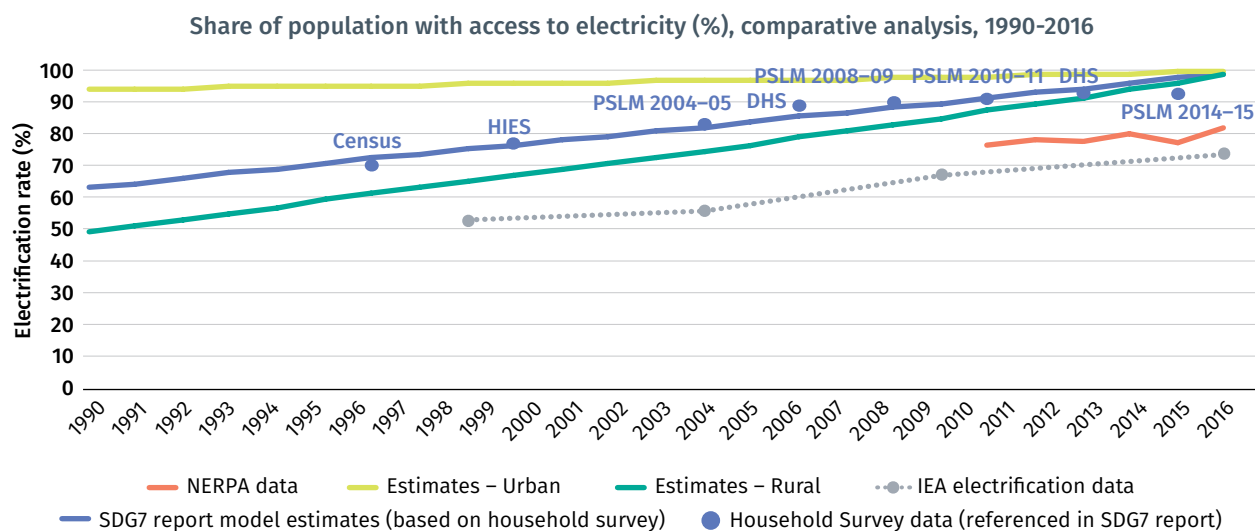
Household survey data disaggregated to identify patterns of electricity access across different socioeconomic groups in Nigeria show a steady improvement in access rates as overall household welfare rises. The access rate of the top quintile is 2.5 times that of the bottom quintile, and the access rates of the middle three quintiles differ by about 6 percentage points, indicating a lower degree of disparity in access rates across consumption quintiles than is seen in the largest access deficit countries in Sub-Saharan Africa. Notably, gender-disaggregated access rates show that access rates for female-headed households are higher compared to male-headed households by 5.5 percentage points, compared to a more equal distribution in the largest access deficit countries in Sub-Saharan Africa. Overall, household consumption drives access disparity in Nigeria to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

PAKISTAN

Electrification trends



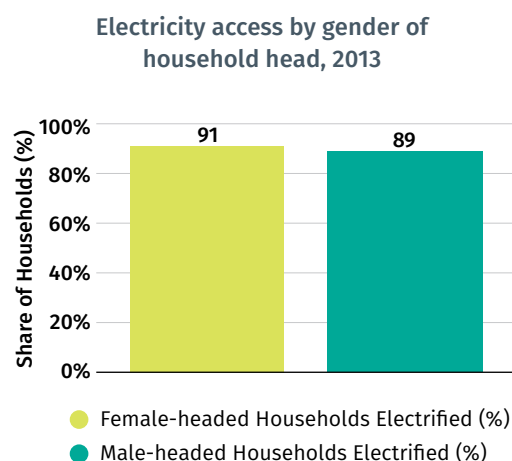
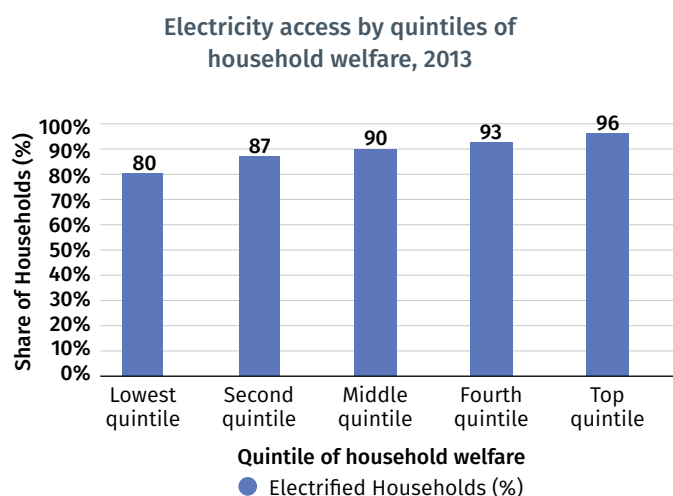
Source: World Bank 2018, NERPA, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
74	Government Report based on Census 2017	82.4	Utility – Formal: NEPRA State of Industry Report, 2016
99	Tracking SDG 7 report: based on model estimate, 2016	1.7	Utility – Informal
73.6	World Energy Outlook 2017: Grid connections: based on Power System Statistics 2016, National Transmission and Dispatch Company. Off-grid: based on Alternate Energy Development Board (AEDB), Islamabad	0	Solar (Tier 1 and above): IRENA, 2016

Pakistan's latest household survey (PSLM, 2014–15) reported that 93.5% of the population has access to electricity, ranging from 98.7% in urban areas to 90.4% in rural areas. Model estimates, based on historical progress, suggest that the access rate should have reached about 99% by 2016. In parallel, the regulator NERPA reported aggregated connections across all distribution utilities at 25.6 million in 2016. On the basis of the number of connections and a household size of 6.2, the formal grid connection rate is estimated at 82.4%. Meanwhile, the regulator reports nontechnical losses of 1.58%. Using Pakistan's average household consumption of 1,628.7 kWh/year, it is estimated that an additional 1.7% of population may be obtaining grid electricity through informal connections, notably through shared metered connections. The small remaining margin between formal and informal utility coverage at 92.1% and access rates of 93.5% reported in the household survey could be attributable to off-grid options such as diesel generation and rechargeable batteries. According to IRENA, in Pakistan, none of the population relied on solar home systems, solar mini-grids, or solar lighting systems providing Tier 1 and above service in 2016.

Patterns of electrification

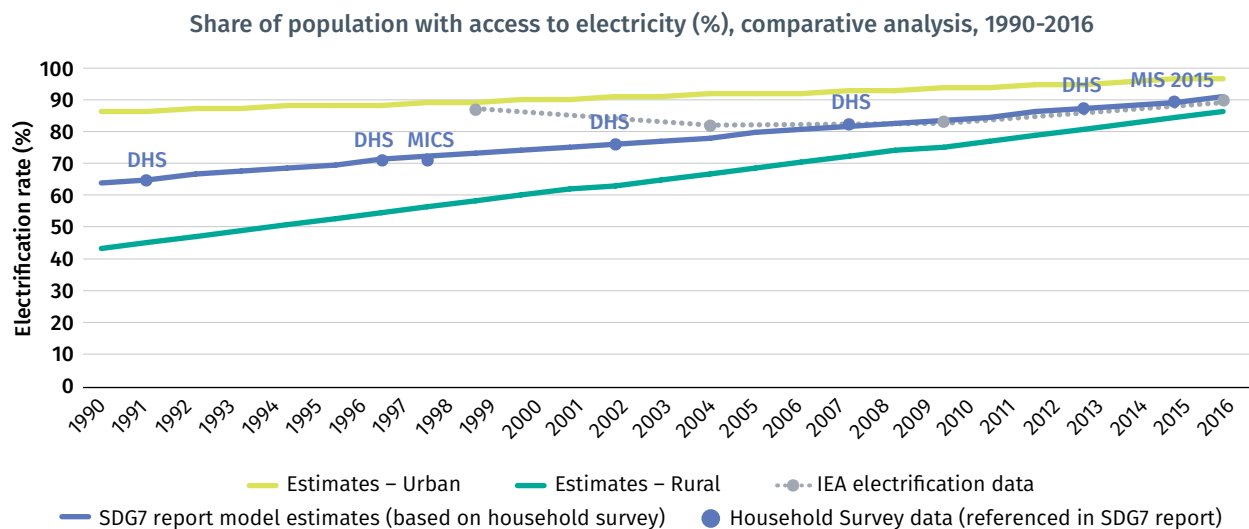
Disaggregated household survey data by socio-economic groups in Pakistan shows that there is a steady improvement in access rates as overall household welfare rises. The difference in access rate of 1.2 times between the top quintile and the bottom quintile, is lower than the average of 1.6 times difference for the largest access deficit countries in Asia. The access rates of the middle three quintiles differ by about 3 percentage points. Notably, gender-disaggregated access show that access rates for female-headed households are higher compared to male-headed households by over 2 percentage points, which is not typical of the largest access deficit countries in Asia. Overall, household consumption drives access disparity in Pakistan to a greater extent than gender.



Source: [GMD] ([SAR]TSD/World Bank – latest year available)

PHILIPPINES

Electrification trends

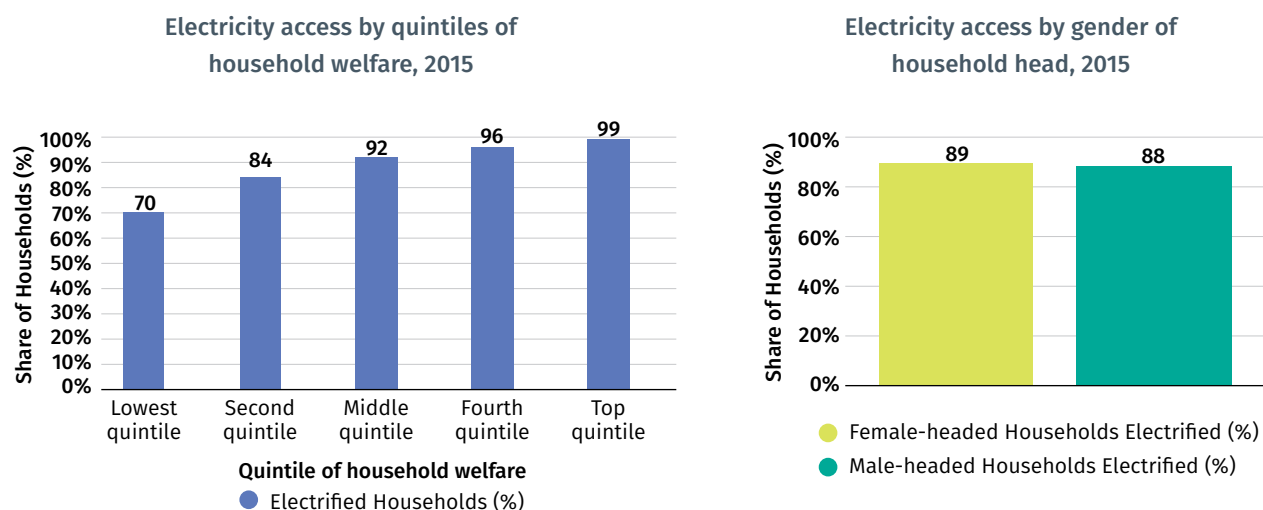


Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
-	No government report available	-	Utility - Formal
91	Tracking SDG 7 report: based on model estimate, 2016	-	Utility - Informal
89.6	World Energy Outlook 2017: based on Department of Energy Philippines, 2015	0	Solar (Tier 1 and above): IRENA, 2016

The Philippines' latest household survey (World Bank Poverty Global Practice, 2015) reported that 89.1% of the population has access to electricity, ranging from 95.9% in urban areas to 85.1% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 91% by 2016. Information on utility connections is highly disaggregated because the country's power system is unbundled, with more than 100 DISCOs and cooperatives. According to IRENA, no population relied on solar home systems, solar mini-grids, or solar lighting systems providing Tier 1 and above service in 2016.

Patterns of electrification

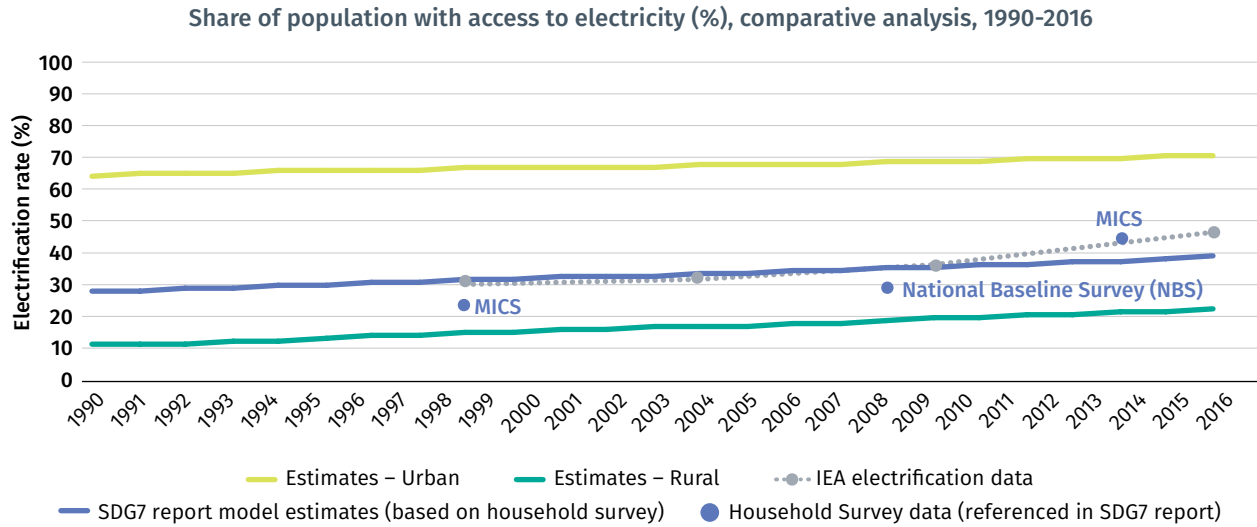
In the Philippines, disaggregating household survey data on access by consumption quintiles (from poorest to richest) shows an improvement in access rates as overall household welfare rises. The access rate of the top quintile is 1.4 times the access rate of the bottom quintile, with the access rate increasing by 14 percentage points from the bottom quintile to the second quintile. These trends are in line with those seen in the largest access deficit countries in Asia. Notably, gender-disaggregated access rates show that access rates for female-headed households are higher than for male-headed households by over 1 percentage point. Overall, household consumption drives access disparity in Philippines to a greater extent than gender.



Source: [GMD] ([EAP]TSD/World Bank – latest year available)

SUDAN

Electrification trends



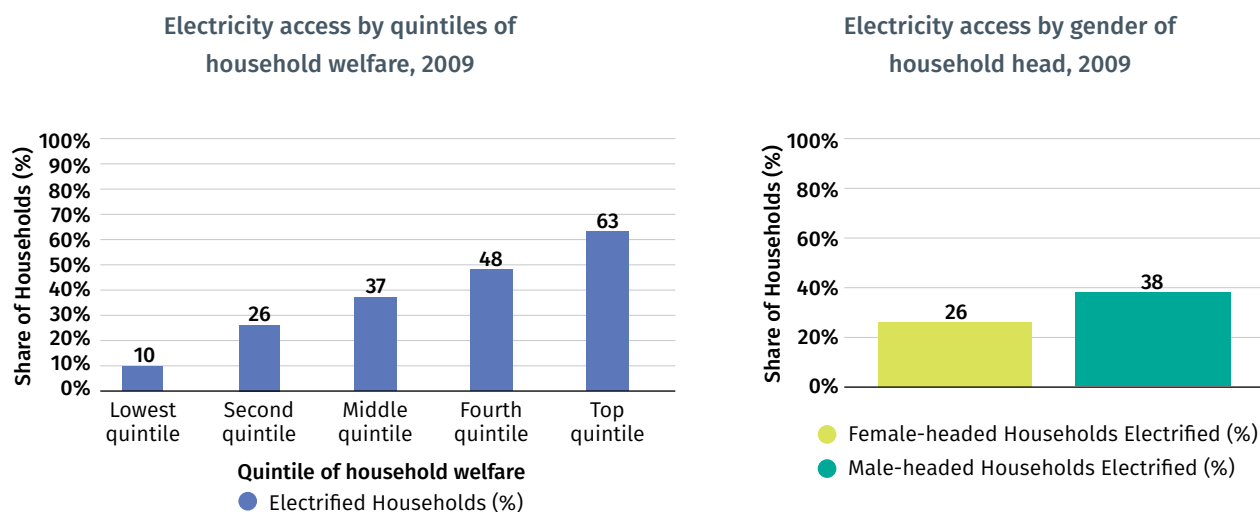
Source: World Bank 2018, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
42.6	Government Report: GoS 2017	-	Utility – Formal
38.5	Tracking SDG 7 report: based on model estimate, 2016	-	Utility – Informal
46.2	World Energy Outlook 2017: based on MICS (2014) with off-grid estimates	-	Solar

Sudan's latest household survey (MICS, 2014) reported that 44.9% of the population has access to electricity, ranging from 76.3% in urban areas to 31.7% in rural areas. Model estimates, based on historical progress, suggest the access rate should have reached about 38.5% by 2016. No data is available from the utility or on the development of solar off-grid in the country.

Patterns of electrification

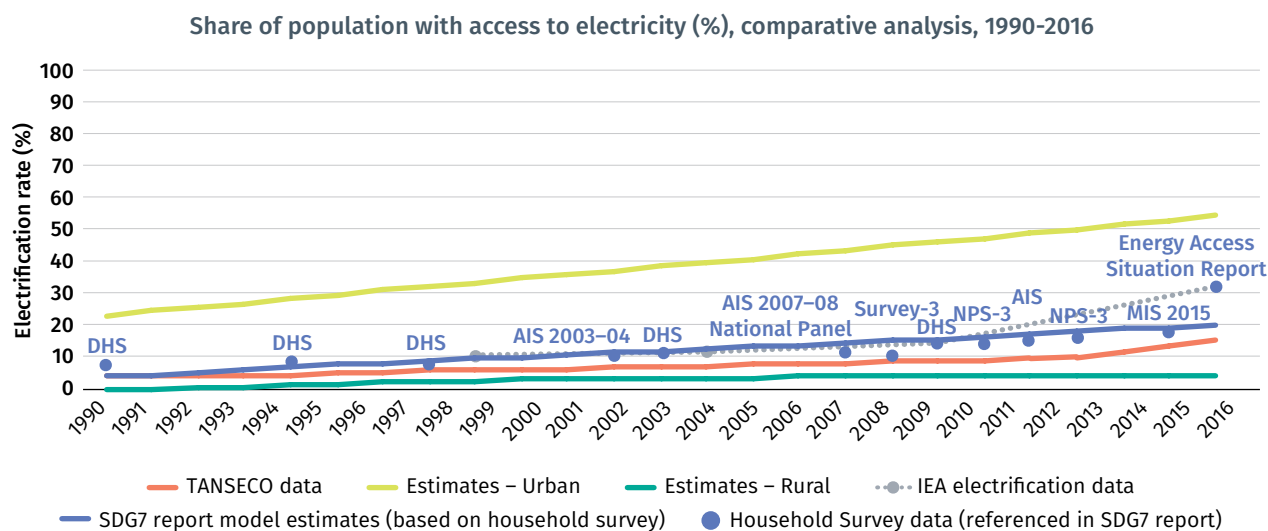
Household survey data can also be disaggregated to identify patterns of electricity access across different socioeconomic groups. In Sudan, disaggregating access by consumption quintiles (from poorest to richest) shows a steady improvement in access rates as overall household welfare rises. The access rate of the top quintile is 6 times that of the bottom quintile, and the access rates of the middle three quintiles differ by about 11 percentage points. These trends are in line with the average of the largest access deficit. Particularly, gender-disaggregated access rates show that access rates for male-headed households are higher compared to female-headed households by 12 percentage points, significantly different from the gender parity in access seen in Sub-Saharan Africa. Overall, household consumption as well as gender could be driving access disparity in Sudan.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

TANZANIA

Electrification trends



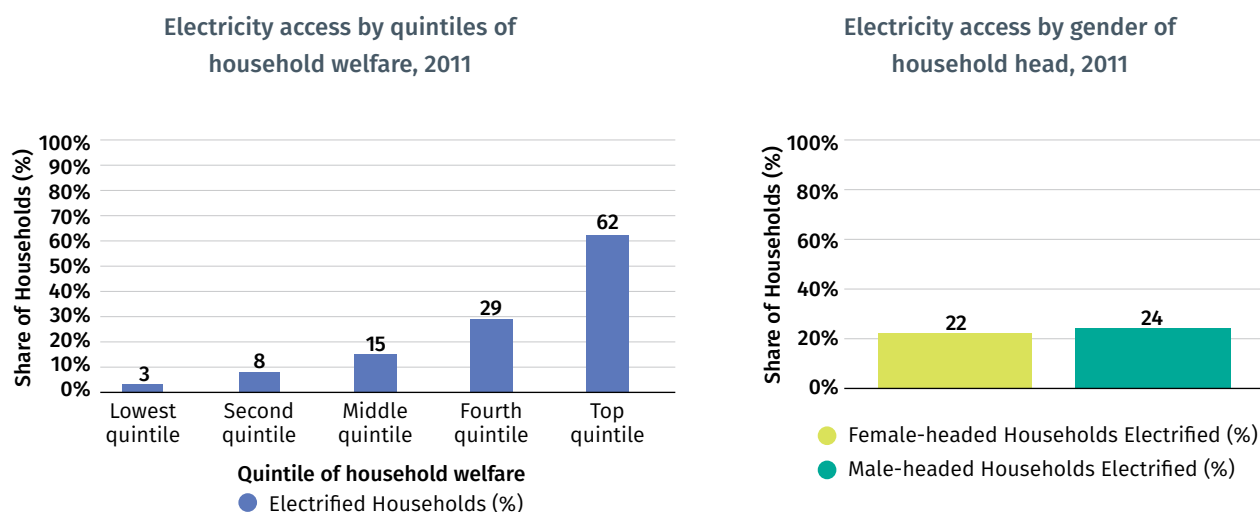
Source: World Bank 2018, EWURA annual reports, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
33	Government Report: Tanzania Energy Access Situation Report 2016	15.4	Utility – Formal: Energy and Water Utility Regulatory Authority (EWURA) annual report, 2016
		0.2	Utility – Informal: TANESCO Financial Statement, 2015
32.8	Tracking SDG 7 report: based on Tanzania Energy Access Situation Report, 2016	24.6	Utility - Total: Tanzania Energy Access Situation Report, 2016
32.7	World Energy Outlook 2017: based on Tanzania Energy Access Situation Report 2016 and off-grid rate reported by government, 2016	8.1	Solar (Tier 1 and above): Tanzania Energy Access Situation Report, 2016

Tanzania's latest household survey (Energy Access Situation Report, 2016) reported that 32.8% of the population has access to electricity, ranging from 65.3% in urban areas to 16.9% in rural areas. In parallel, the Energy and Water Utility Regulatory Authority (EWURA) reported 1.7 million household connections in 2016. On the basis of the connections and a household size of 4.9, the formal grid connection rate is estimated at 15.4%. Meanwhile, the utility estimated 0.8% of nontechnical loss in 2015. Assuming Tanzania's average household consumption is 1,392 kWh/year, an estimated additional 0.2% of the population may be obtaining grid electricity through informal connections. However, the 2016 Energy Access Situation Report, using household survey data, reported a much higher rate of grid connection at 24.6%. According to that report, 8.1% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016.

Patterns of electrification

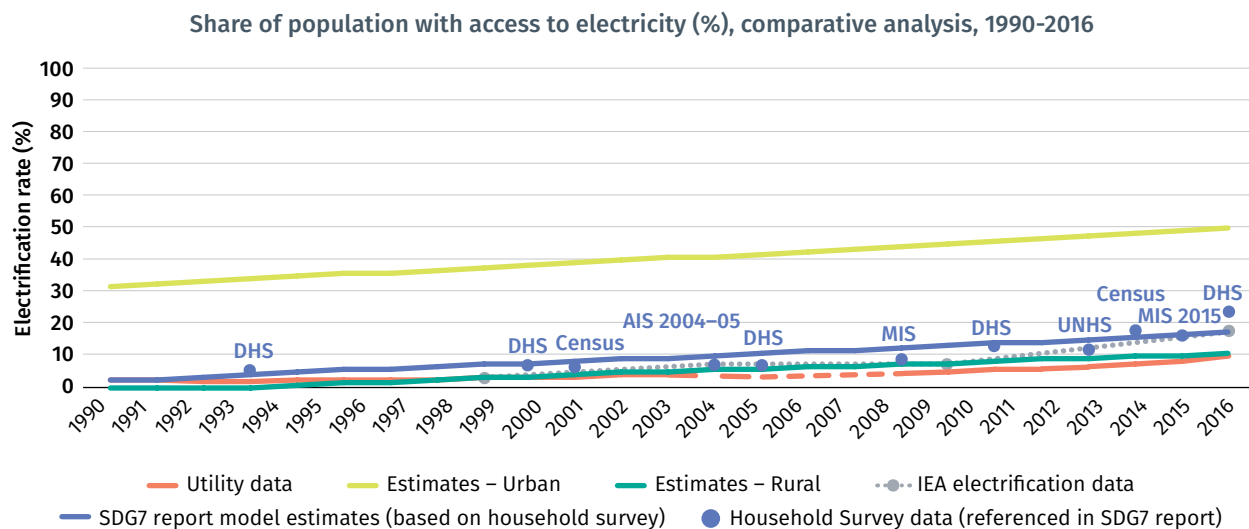
In Tanzania, disaggregating access by consumption quintiles (from poorest to richest) shows a significant increase in access rates as overall household welfare rises. The access rate of the top quintile is 19 times that of the bottom quintile, and the access rate of the fourth quintile is half that of the top quintile. This disparity is more significant than what is seen in other large access deficit countries in Sub-Saharan Africa. Gender-disaggregated access rates show that access rates for male-headed households are higher compared to female-headed households by 1.3 percentage points. Overall, household consumption drives access disparity in Tanzania to a greater extent than gender.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

UGANDA

Electrification trends



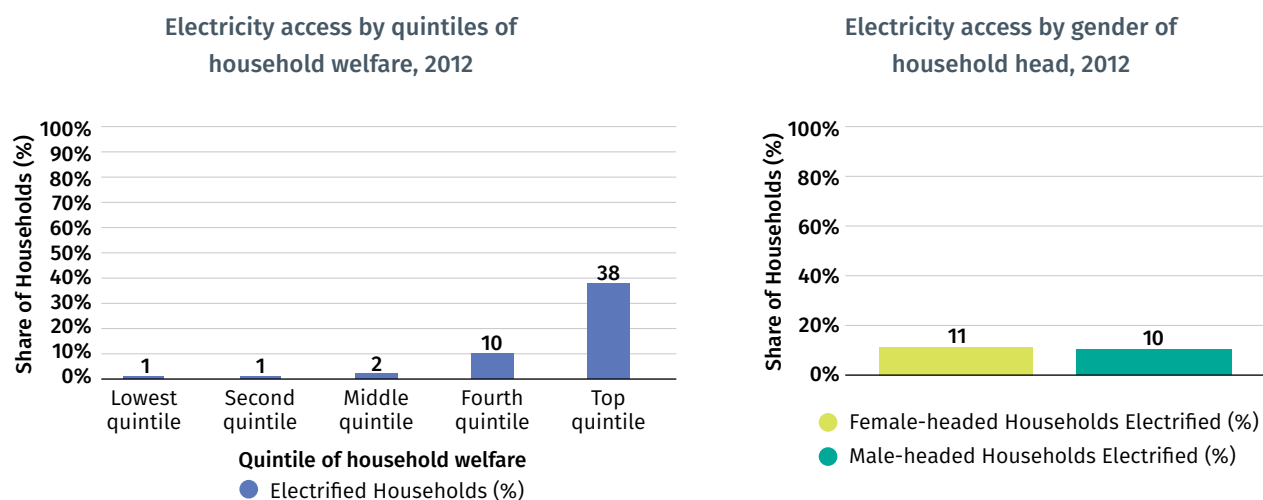
Source: World Bank 2018, UMEME Annual reports, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
-	No government report available	11.2	Utility – Formal: UMEME Annual Report, 2016
26.7	Tracking SDG 7 report: based on DHS 2016	-	Utility – Informal
19.4	World Energy Outlook 2017: based on Contact at Ministry of Energy and Mineral Development, 2016	3.1	Solar (Tier 1 and above): IRENA, 2016

Uganda's latest household survey (DHS, 2016) reported that 26.7% of the population has access to electricity, ranging from 57.5% in urban areas to 18% in rural areas. In parallel, the utility UMEME, whose market share is 90%, reported 0.95 million connections in 2016. On the basis of the connections and a household size of 4.9, the formal grid connection rate is estimated at 11.2%. There are no official statistics on nontechnical losses that could be used to gauge the extent of informal connections. An illustrative simulation of 1% nontechnical losses, based on Uganda's average household consumption of 1,054 kWh/year, would translate into informal access of 0.2% of the population. The substantial gap between electrification rates reported by household surveys and those attributable to grid electrification by the utility can be partially explained by the development of off-grid solutions. According to IRENA, 3.1% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016. Other forms of self-supply like diesel generators or rechargeable batteries may help to explain the remaining difference.

Patterns of electrification

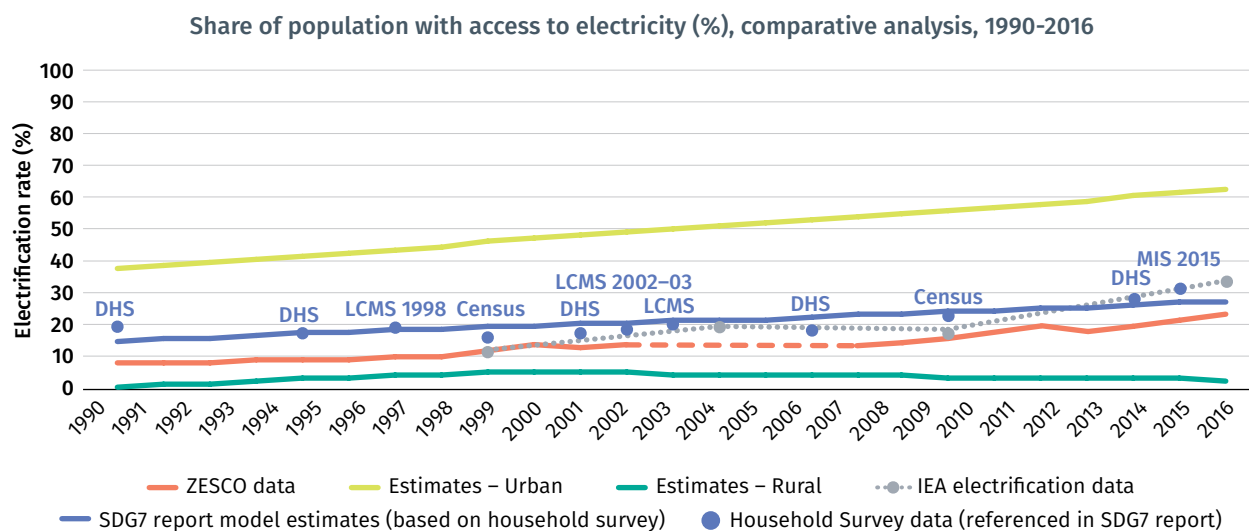
Disaggregated household survey data by socioeconomic groups in Uganda show a striking increase in access rates as overall household welfare rises. The access rate of the top quintile is 36 percentage points higher than that of the bottom quintile, and the access rate of the fourth quintile is one-fourth that of the top quintile. The difference between the top quintile and the bottom four quintiles is more pronounced in Uganda compared to the average for the largest access deficit countries in Sub-Saharan Africa. Notably, gender-disaggregated access rates show that access rates for female-headed households are marginally higher than male-headed households. Overall, household consumption, not gender, drives access disparity in Uganda.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)

ZAMBIA

Electrification trends



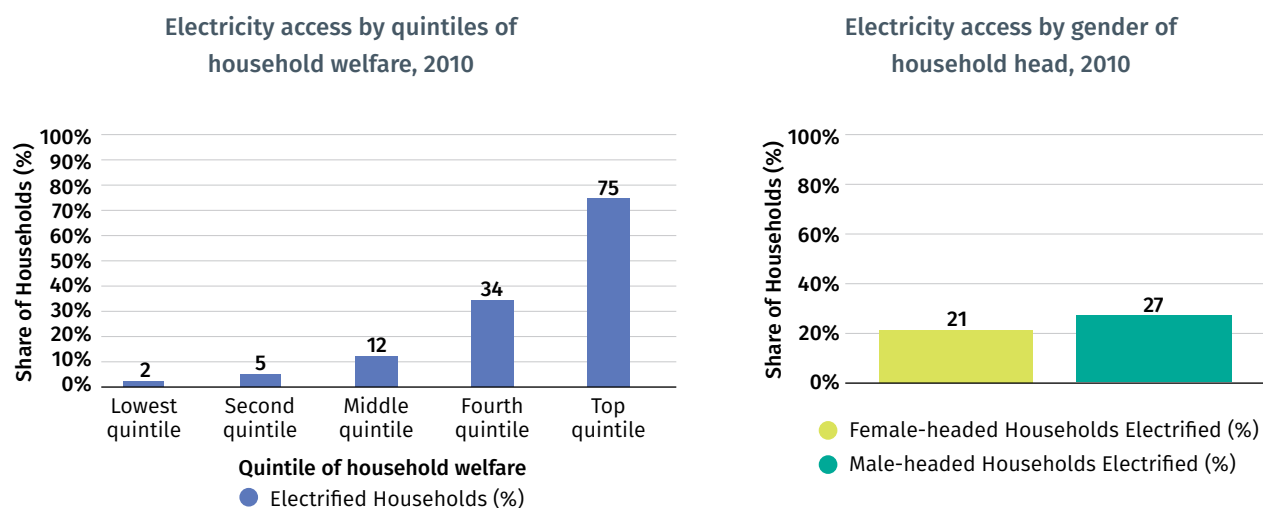
Source: World Bank 2018, Energy Regulatory Board Energy Sector Reports, WEO 2017, World Bank WDI

Headline Electrification Rate (% of total population)		Electrification Sub-Categories (% of total population)	
–	No government report available	23.4	Utility – Formal: Energy Regulation Board, Energy Sector Report, 2016
27.2	Tracking SDG 7 report: based on model estimate, 2016	–	Utility – Informal
33.7	World Energy Outlook 2017: based on Department of Planning and Information, Ministry of Energy, Zambia, 2016	0.003	Solar (Tier 1 and above): IRENA, 2016

Zambia's latest household survey (Living Condition Measurement Survey, 2015) reported that 31.1% of the population has access to electricity, ranging from 67.7% in urban areas to 3.7% in rural areas. Model estimates, based on historical progress, suggest that the access rate should have reached about 27.2% by 2016. In parallel, the Energy Regulatory Board reported 0.76 million household connections in 2016. Based on the connections and a household size of 5.1, the formal grid connection rate is estimated at 23.4%. There are no official statistics on nontechnical losses to gauge the prevalence of informal connections. An illustrative simulation shows that nontechnical losses of 1%, given Zambia's average household consumption is 3,953 kWh/year, could potentially provide informal access to 0.31% of population in 2016. Otherwise, the gap between utility connection rates and access reported in household surveys could potentially be attributed to off-grid solutions, including diesel generation and rechargeable batteries. According to IRENA, only a negligible share of 0.003% of the population relied on solar home systems, solar mini-grids, and solar lighting systems providing Tier 1 and above service in 2016.

Patterns of electrification

In Zambia, disaggregating access by consumption quintiles (from poorest to richest) shows a stark increase in access rates as overall household welfare rises. The access rate of the top quintile is 36 times that of the bottom quintile, and twice that of the fourth quintile. This disparity in the top quintiles is similar to what is seen in countries with the largest access deficit in Sub-Saharan Africa. Notably, gender-disaggregated access rates show that access rates for male-headed households are higher than female-headed households by over 5 percentage points, in contrast to the gender parity in access seen in Sub-Saharan Africa. Overall, household consumption, not gender, drives access disparity in Zambia.



Source: [GMD] ([SSA]TSD/World Bank – latest year available)