Satellite Observations Reveal Inequalities in the Progress and Effectiveness of Recent Electrification in Sub-Saharan Africa

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Supplemental Information

Figure S1: Multi-tier matrix for measuring access to household electricity supply. Source: ref 1.
Figure S2: Validation plots for the electricity access estimates. Panel A: ESMAP/World Bank data; Panel B: IEA Access Database; Panel C: DHS province-level surveys.
Figure S3 shows a line plot – by country – of the electrification levels reported by the *Tracking SDG7: The Energy Progress Report 2019* (ref. 2). It reveals that a large number of countries seem to have kept quasi-linear changes in their reported electricity access level. Testing this hypothesis in a regression framework yields to a highly significance of the linear time trend (at a 1% level), but conversely it points to a rejection of the existence of a quadratic or cubic time trend at a 5% level of statistical significance.

**Figure S3:** Electricity access level progress (2010-2017) according to the database of the Tracking SDG7 report database (ref. 2).
Figure S4: Distribution of nighttime light radiances and thresholds identified to define electricity access tiers for national, urban, and rural areas.
Figure S5: Share of the national, urban, and rural population with access to electricity in each access tier according to this paper estimates and the World Bank Multi-Tier Framework field data for Ethiopia, Rwanda, and Zambia.
**Table S1: DHS surveys data regression results**

| Dependent variable: | Elect. access level 2019 | Elect. progress 2014-2019 | Average access tier | TV ownership | Refrigerator ownership | Mobile telephone ownership | Radio ownership |
|---------------------|--------------------------|---------------------------|---------------------|--------------|------------------------|---------------------------|---------------|
|                     | (1)                      | (2)                       | (3)                 | (4)          | (5)                    | (6)                        | (7)            |
| Wealth distribution: Gini coefficient | -1.463*** | 0.093*** | -4.790*** | 19.823*** | 13.181*** | 10.054*** | 6.812*** |
|                      | (0.142)                  | (0.034)                   | (0.483)             | (0.923)      | (0.681)                | (0.830)                   | (0.745)       |
| Average access tier | 1.045***                 | -0.020                    | 2.588***            | 20.924***    | 11.405***              | 46.493***                  | 38.608***     |
| Constant            | (0.067)                  | (0.016)                   | (0.226)             | (2.843)      | (2.098)                | (2.557)                   | (2.293)       |

|                      | (188)                    | (188)                     | (188)              | (216)        | (216)                  | (216)                      | (216)         |
| Observations        | 0.579                    | 0.412                     | 0.464              | 0.828        | 0.780                  | 0.780                      | 0.670         |
| R²                  | Residual Std. Error      | 0.542                     | 0.361              | 0.418        | 0.814                  | 0.762                      | 0.762         | 0.643         |
| Adjusted R²         | F Statistic              | 0.194 (df = 172)          | 0.047 (df = 172)   | 0.659 (df = 172) | 10.257 (df = 199) | 7.570 (df = 199) | 9.225 (df = 199) | 8.274 (df = 199) |
|                     | 15.776*** (df = 15; 172) | 8.040*** (df = 15; 172)   | 9.945*** (df = 15; 172) | 59.987*** (df = 16; 172) | 44.016*** (df = 16; 172) | 43.988*** (df = 16; 172) | 25.236*** (df = 16; 172) |
| Country fixed-effects | Yes                      | Yes                       | Yes                | Yes          | Yes                    | Yes                        | Yes            |

**Note:** *p<0.1; **p<0.05; ***p<0.01
### Table S2: ISO3—country names codebook

| ISO3 | Country name                     |
|------|----------------------------------|
| AGO  | Angola                           |
| BDI  | Burundi                          |
| BEN  | Benin                            |
| BFA  | Burkina Faso                     |
| BWA  | Botswana                         |
| CAF  | Central African Republic         |
| CIV  | Côte d’Ivoire                    |
| CMR  | Cameroon                         |
| COD  | Congo (Dem. Rep. of)             |
| COG  | Congo (Rep. of)                  |
| ERI  | Eritrea                          |
| ETH  | Ethiopia                         |
| GAB  | Gabon                            |
| GHA  | Ghana                            |
| GIN  | Guinea                           |
| GMB  | Gambia                           |
| GNB  | Guinea-Bissau                    |
| GNQ  | Equatorial Guinea                |
| KEN  | Kenya                            |
| LBR  | Liberia                          |
| LSO  | Lesotho                          |
| MDG  | Madagascar                       |
| MLI  | Mali                             |
| MOZ  | Mozambique                       |
| MRT  | Mauritania                       |
| MWI  | Malawi                           |
| NAM  | Namibia                          |
| NER  | Niger                            |
| NGA  | Nigeria                          |
| RWA  | Rwanda                           |
| SDN  | Sudan                            |
| SEN  | Senegal                          |
| SLE  | Sierra Leone                     |
| SOM  | Somalia                          |
| SSD  | South Sudan                      |
| SWZ  | Swaziland                        |
| TCD  | Chad                             |
| TGO  | Togo                             |
| TZA  | Tanzania (United Rep. of)        |
| UGA  | Uganda                           |
| ZAF  | South Africa                     |
| ZMB  | Zambia                           |
| ZWE  | Zimbabwe                         |
| Dataset                                                                 | Unit                  | Source       | Time step | Spatial resolution |
|------------------------------------------------------------------------|-----------------------|--------------|-----------|--------------------|
| High-resolution settlement layer                                        | People                | Ref. 3       | 1 year    | 30 m               |
| Global Human Settlement Layer – built up areas and settlement type layers | Class                 | Ref. 4       | 5 years   | 250 m              |
| VIIRS-DNB nighttime light radiance                                      | μW · cm⁻² · sr⁻¹      | Ref. 5       | 1 month   | 450 m              |
| GADM shapefile                                                         | % of people with access | Ref. 6       | Multiple years | Province-level      |
| DHS surveys                                                            | % of people with access | Ref. 7       | Multiple years | Province-level      |
| IEA Energy Access database                                              | % of people with access | Ref. 8       | 1 year    | Country-level       |
| Tracking SDG7: The Energy Progress Report database                      | % of people with access | Ref. 9       | 1 year    | Country-level       |
| Atlas of the Sustainable Development Goals from World Development Indicators database | % of people with access | Ref. 10      | 1 year    | Country-level       |
| ESMAP Multi-tier Framework Surveys                                     | kWh/household/year    | Ref. 11      | 1-2 years | Household-level     |
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