

**One Earth, Volume 2**

**Supplemental Information**

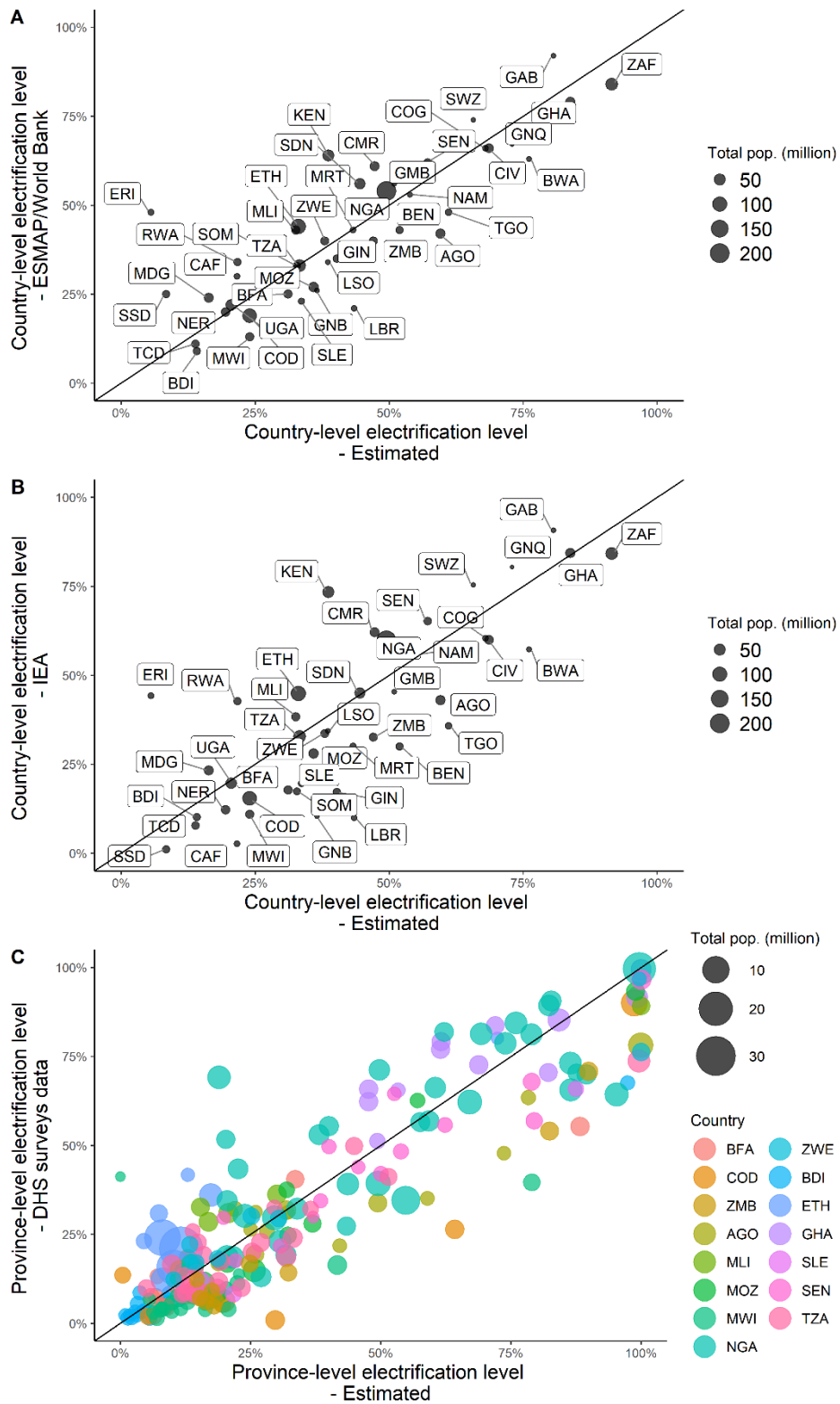
**Satellite Observations Reveal Inequalities  
in the Progress and Effectiveness of Recent  
Electrification in Sub-Saharan Africa**

**Giacomo Falchetta, Shonali Pachauri, Edward Byers, Olha Danylo, and Simon C. Parkinson**

## Supplemental Information

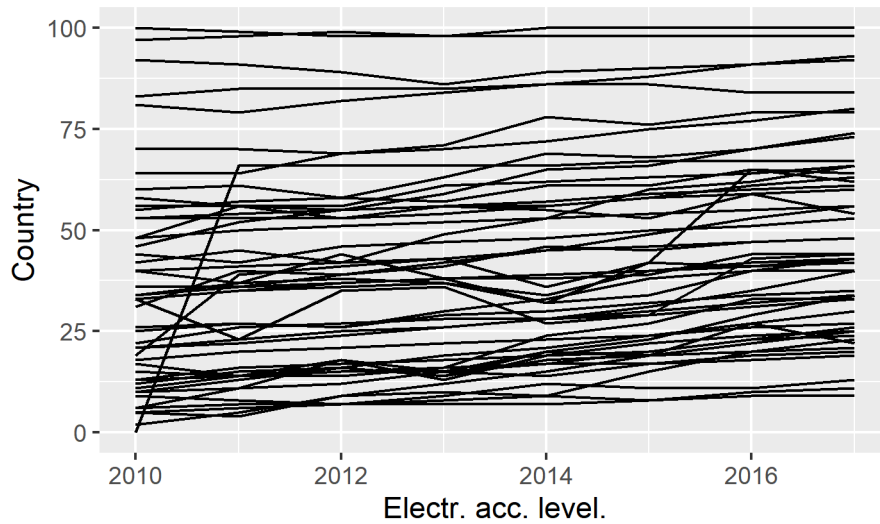
		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
ATTRIBUTES	1. Peak Capacity	Power capacity ratings <sup>28</sup> (in W or daily Wh)	Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
			Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
		OR Services	Lighting of 1,000 lmhr/day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (Duration)	Hours per day	Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
		Hours per evening	Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
	3. Reliability					Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
	4. Quality					Voltage problems do not affect the use of desired appliances	
	5. Affordability					Cost of a standard consumption package of 365 kWh/year < 5% of household income	
6. Legality					Bill is paid to the utility, pre-paid card seller, or authorized representative		
7. Health & Safety					Absence of past accidents and perception of high risk in the future		

**Figure S1:** Multi-tier matrix for measuring access to household electricity supply.  
Source: ref 1.

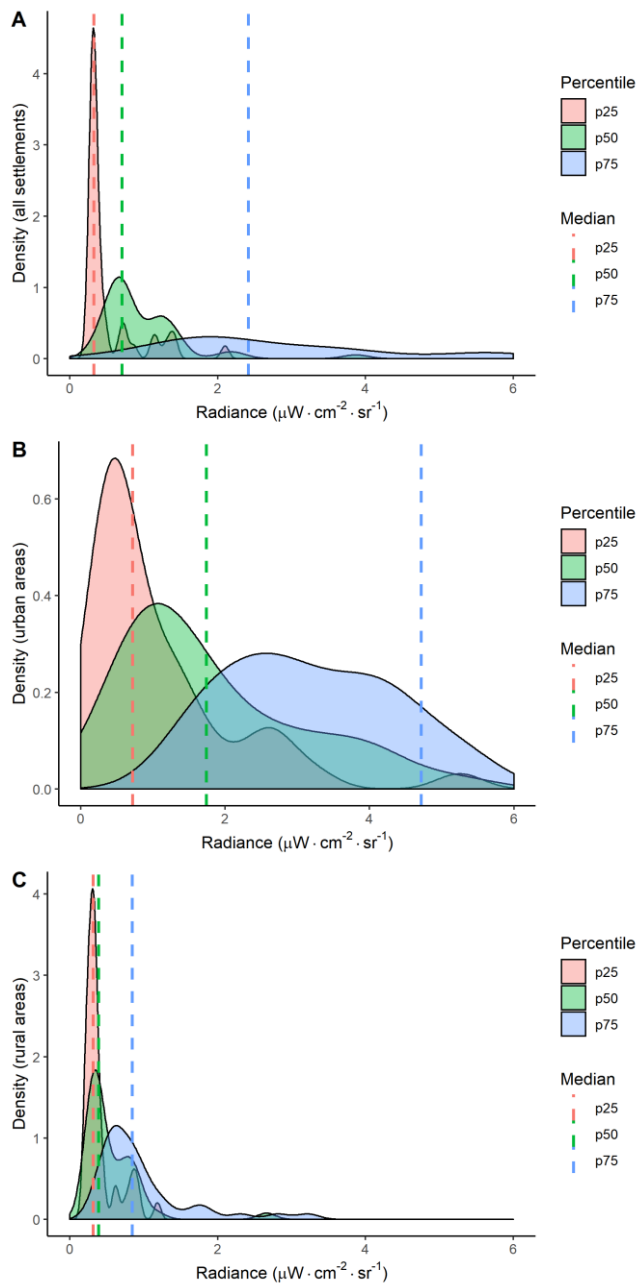


**Figure S2:** Validation plots for the electricity access estimates. Panel A: ESMAP/World Bank data; Panel B: IEA Access Database; Panel C: DHS province-level surveys.

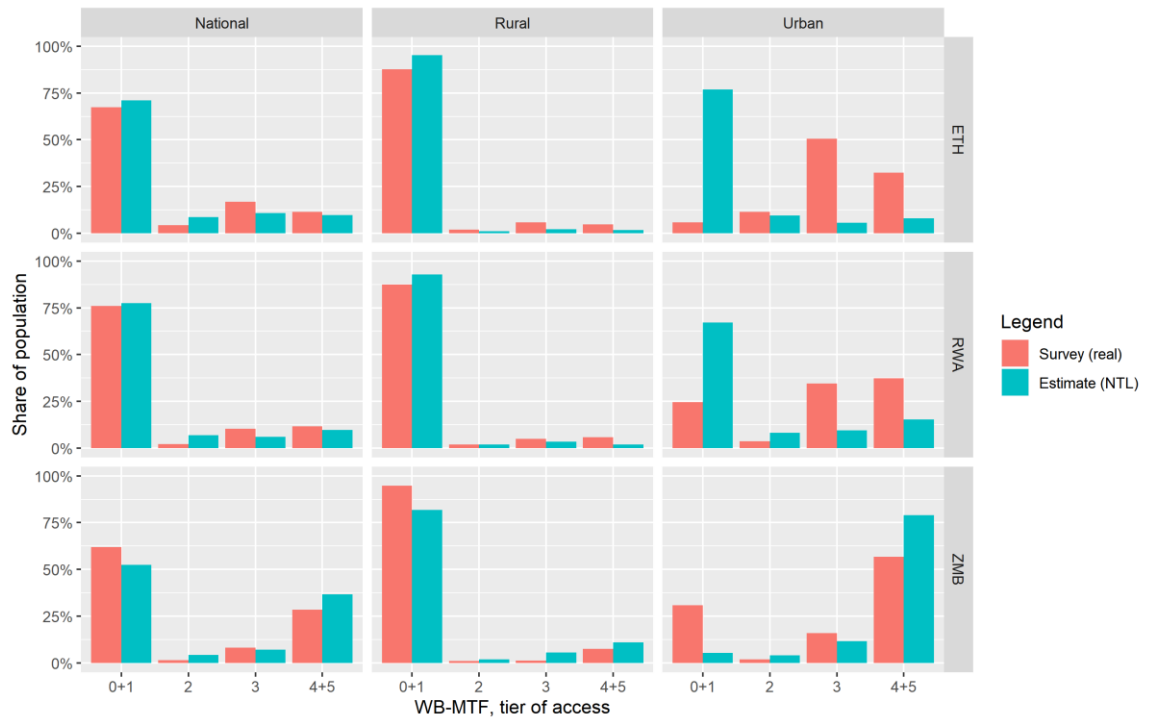
Figure S3 shows a line plot – by country – of the electrification levels reported by the *Tracking SDG7: The Energy Progress Report 2019* (ref. 2). It reveals that a large number of countries seem to have kept quasi-linear changes in their reported electricity access level. Testing this hypothesis in 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 radiance 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**

	<i>Dependent variable:</i>						
	Electr. access level 2019 (1)	Elect. progress 2014-2019 (2)	Average access tier (3)	TV ownership (4)	Refrigerator ownership (5)	Mobile telephone ownership (6)	Radio ownership (7)
<b>Wealth distribution: Gini coefficient</b>	-1.463*** (0.142)	0.093*** (0.034)	-4.790*** (0.483)				
<b>Average access tier</b>				19.823*** (0.923)	13.181*** (0.681)	10.054*** (0.830)	6.812*** (0.745)
<b>Constant</b>	1.045*** (0.067)	-0.020 (0.016)	2.588*** (0.226)	20.924*** (2.843)	11.405*** (2.098)	46.493*** (2.557)	38.608*** (2.293)
<b>Observations</b>	188	188	188	216	216	216	216
<b>R<sup>2</sup></b>	0.579	0.412	0.464	0.828	0.780	0.780	0.670
<b>Adjusted R<sup>2</sup></b>	0.542	0.361	0.418	0.814	0.762	0.762	0.643
<b>Residual Std. Error</b>	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)
<b>F Statistic</b>	15.776*** (df = 15; 172)	8.040*** (df = 15; 172)	9.945*** (df = 15; 172)	59.987*** (df = 16; 199)	44.016*** (df = 16; 199)	43.988*** (df = 16; 199)	25.236*** (df = 16; 199)
<b>Country fixed-effects</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

**Table S2: ISO3– country names codebook**

<b>ISO3</b>	<b>Country name</b>
<b>AGO</b>	Angola
<b>BDI</b>	Burundi
<b>BEN</b>	Benin
<b>BFA</b>	Burkina Faso
<b>BWA</b>	Botswana
<b>CAF</b>	Central African Republic
<b>CIV</b>	Côte d'Ivoire
<b>CMR</b>	Cameroon
<b>COD</b>	Congo (Dem. Rep. of)
<b>COG</b>	Congo (Rep. of)
<b>ERI</b>	Eritrea
<b>ETH</b>	Ethiopia
<b>GAB</b>	Gabon
<b>GHA</b>	Ghana
<b>GIN</b>	Guinea
<b>GMB</b>	Gambia
<b>GNB</b>	Guinea-Bissau
<b>GNQ</b>	Equatorial Guinea
<b>KEN</b>	Kenya
<b>LBR</b>	Liberia
<b>LSO</b>	Lesotho
<b>MDG</b>	Madagascar
<b>MLI</b>	Mali
<b>MOZ</b>	Mozambique
<b>MRT</b>	Mauritania
<b>MWI</b>	Malawi
<b>NAM</b>	Namibia
<b>NER</b>	Niger
<b>NGA</b>	Nigeria
<b>RWA</b>	Rwanda
<b>SDN</b>	Sudan
<b>SEN</b>	Senegal
<b>SLE</b>	Sierra Leone
<b>SOM</b>	Somalia
<b>SSD</b>	South Sudan
<b>SWZ</b>	Swaziland
<b>TCD</b>	Chad
<b>TGO</b>	Togo
<b>TZA</b>	Tanzania (United Rep. of)
<b>UGA</b>	Uganda
<b>ZAF</b>	South Africa
<b>ZMB</b>	Zambia
<b>ZWE</b>	Zimbabwe



**Table S3:** Datasets used in the modelling framework

<b>Dataset</b>	<b>Unit</b>	<b>Source</b>	<b>Time step</b>	<b>Spatial resolution</b>
High-resolution settlement layer	People	Ref. <sup>3</sup>	1 year	30 m
Global Human Settlement Layer – built up areas and settlement type layers	Class	Ref. <sup>4</sup>	5 years	250 m
VIIRS-DNB nighttime light radiance	$\mu\text{W} \cdot \text{cm}^{-2} \cdot \text{sr}^{-1}$	Ref. <sup>5</sup>	1 month	450 m
GADM shapefile	-	Ref. <sup>6</sup>	-	-
DHS surveys	% of people with access	Ref. <sup>7</sup>	Multiple years	Province-level
IEA Energy Access database	% of people with access	Ref. <sup>8</sup>	1 year	Country-level
Tracking SDG7: The Energy Progress Report database	% of people with access	Ref. <sup>9</sup>	1 year	Country-level
Atlas of the Sustainable Development Goals from World Development Indicators database	% of people with access	Ref. <sup>10</sup>	1 year	Country-level
ESMAP Multi-tier Framework Surveys	kWh/household/year	Ref. <sup>11</sup>	1-2 years	Household-level

## Supplemental References

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3. Facebook Connectivity Lab, and Center for International Earth Science Information Network - CIESIN - Columbia University (2016). High Resolution Settlement Layer (HRSL).
4. Pesaresi, M., Huadong, G., Blaes, X., Ehrlich, D., Ferri, S., Gueguen, L., Halkia, M., Kauffmann, M., Kemper, T., Lu, L., et al. (2013). A global human settlement layer from optical HR/VHR RS data: concept and first results. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 6, 2102–2131.
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