

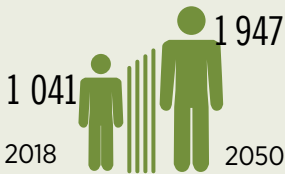
ENERGY TRANSFORMATION

SUB-SAHARAN AFRICA

Regional analysis extends from the Sahel region to the continent's southernmost tip, in addition to associated island countries.

STATUS/CHARACTERISTICS AND NEEDS:

Population (millions)



Current: **14% of global population** (end-2018), Highest regional shares in Nigeria (18%) and Ethiopia (10%).

2050 outlook: Average **2% per year increase** to **1 947 million**, or 21% of global population.

IRENA analysis based on E3ME.

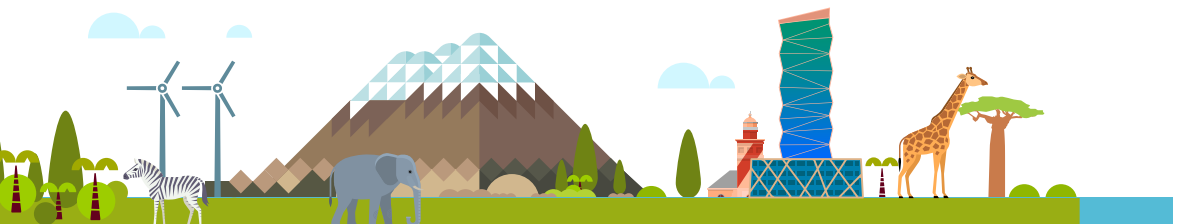
GDP per capita (thousand USD 2015)

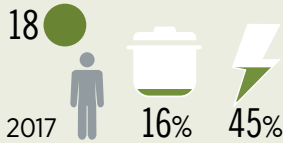


Current: **Well below the global average** (10.9).

2050 outlook: **Swift development;** **▶ PES: CAGR = 3.2%**

IRENA analysis based on E3ME.



Energy consumption
(GJ/capita) and
energy access (%)**Energy consumption per capita:**

Current: well below global average
(51 GJ/year).

Electricity access:

Lowest in the world, with two-thirds of region's population lacking access.

Expansion doubling annually since 2000, with about 18 million people now gaining access each year.

Clean cooking access:

Growing numbers of people without access, resulting in substantial degradation of forests and indoor air pollution.

Source: Access to electricity, 2017 values (World Bank Group, 2019a), access to clean cooking, 2016 values (World Bank Group, 2019b), TFEC, 2017 values (IEA, 2019), 2050 values based on IRENA analysis.

Fossil fuel net import**Current status:**

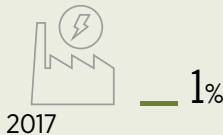
Holds over half the oil and gas reserves of the African continent. Bioenergy dominates the primary energy mix, accounting for 60% of primary energy demand but the share of energy supply from modern renewables is only about 10%.

2050 outlook:

Rising air pollution and resource challenges; Vast untapped renewable energy potential.

► **PES:** The total generation (est. 975 TWh) just represents **1%** of overall renewable power potential.

Note: Current status, IRENA analysis based on proportion of net imports of fossil fuels in TPES, 2017 values (IEA, 2019). 2050 outlook, IRENA analysis and potential based on Deng *et al.* (2015).

Energy-intensive industries (% in global consumption)**Current status:**

Only a tiny share (1%) of global consumption comes from the region's energy intensive industries.

2050 outlook:

With accelerated demand growth, low carbon technologies will play a key role.

IRENA analysis based on 2017 values (IEA, 2019).

Energy-related CO₂ emissions per capita
(tCO₂/capita)**Recent:**

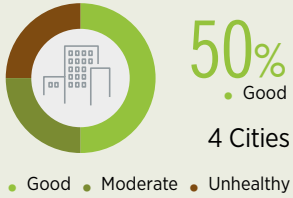
Region's annual emissions: 0.8 Gt (2018). 2% of global energy-related CO₂ emissions.

2050 outlook:

► **PES: 23% increase to 0.97 Gt** based on current policies.

Note: 2050 values based on IRENA analysis and historical data based on Global Carbon Atlas (2019).

Urban air quality (%)



Deteriorating urban air quality, with some cities having fine particle pollution (PM 2.5) among highest in world (dataset limited to 4 cities). **Indoor biomass combustion causes thousands of premature deaths each year.**

IRENA analysis based on PM 2.5 concentration, 2016 and 2017 values (WHO, 2019).

Electricity prices and renewables costs

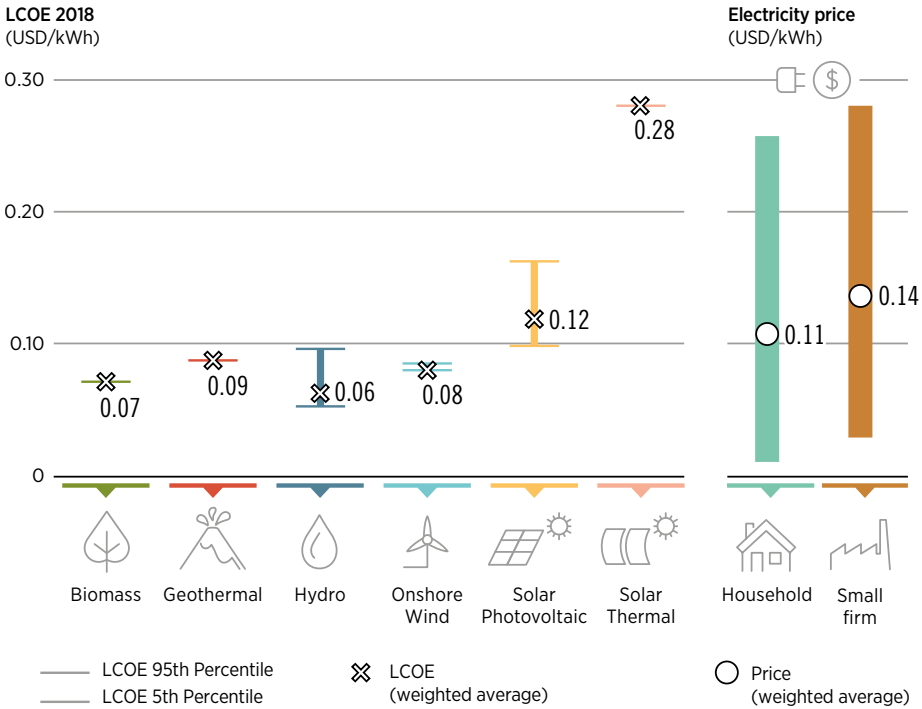
Electricity price:

Lower range for households and **mid-range** for industries (compared to other regions). The prices are very high compared to the average income.

Renewable cost and auctions:

Decentralised mini-grid systems attractive to reach rural/remote populations.

Sub-Saharan Africa



LCOE based on IRENA (2019a) and electricity prices based on Global Petrol Prices (2019). Note: The LCOE data is for projects commissioned in 2018. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world.

ENERGY TRANSFORMATION: KEY BENEFITS

1

SOCIAL AND ECONOMIC PROGRESS

- ▶ Economic growth leading to poverty alleviation
- ▶ Distributed power for isolated communities and local job creation
- ▶ Transformative health and education impacts



2

INVESTMENTS TO BOOST ENERGY SECURITY

- ▶ Reduced network losses, improved financial performance
- ▶ Long-term finance for capital-intensive projects
- ▶ Robust regulatory frameworks



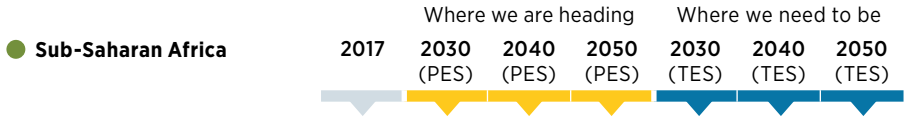
3

CLEAN AIR, LOWER EMISSIONS

- ▶ Minimised reliance on traditional fuelwood
- ▶ Use of modern energy for productive uses
- ▶ Clean cooking and electricity access



ENERGY TRANSFORMATION ROADMAP TO 2050



Energy (EJ)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Supply (TPES)	25	17	19	20	13	24	35
Consumption (TFEC)	18	12	13	13	9	17	26

Renewables shares (modern)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Supply (TPES)	7%	24%	29%	34%	43%	75%	89%
Consumption (TFEC)	8%	22%	26%	29%	42%	72%	86%
Power generation	26%	48%	53%	51%	67%	88%	95%



Electricity share in final energy consumption	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
End-use consumption	7%	16%	20%	23%	23%	33%	48%
Industry	26%	27%	28%	29%	31%	23%	29%
Transport	1%	1%	1%	1%	2%	20%	47%
Buildings	4%	26%	43%	58%	57%	78%	89%

Renewable installed capacity (GW)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Bioenergy	1	7	10	12	11	27	56
Hydropower	27	44	72	54	55	95	108
Solar PV	3	49	69	85	79	255	548
Wind	3	20	28	35	33	131	314



Biofuels	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Liquid biofuels (billions of litres per year)	0.04	8	10	12	13	17	21



CO ₂ emissions (energy-related)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Annual level (Gt CO ₂ /yr)	0.8	0.8	1.0	1.0	0.6	0.5	0.3
Reduction vs. today	NA	6%	24%	26%	-24%	-35%	-60%

Note: The findings presented in the table are based on IRENA's REmap (Renewable Energy Roadmap) approach which is consistent with the Paris climate targets. In addition, IRENA has also been conducting in-depth power sector analysis and long-term planning on the African continent, using a capacity expansion modelling tool that IRENA developed for 47 African countries - the SPLAT model. For more details, please visit <https://irena.org/energytransition/Energy-Planning-Support/System-Planning-Test-Model>

● Sub-Saharan Africa

Where we are heading
**Planned Energy
Scenario 2016 - 2050**
(PES)

Where we need to be
**Transforming Energy
Scenario 2016-2050**
(TES)

**Energy system investments (average annual, 2016-50) USD billion/year**

	Planned Energy Scenario 2016 - 2050 (PES)	Transforming Energy Scenario 2016-2050 (TES)
Power	17	56
- Renewable	7	34
- Non-renewable	4	4
- Power grids and system flexibility	6	18
Industry (RE + EE)	2	10
Transport (electrification + EE)	3	20
Buildings (RE + EE)	13	19
Biofuel supply	1	3
Renewable hydrogen – electrolyzers	0.02	0.2

Note: RE = renewable energy; EE = energy efficiency

The findings in this report consider targets and developments as of April 2019. The wind and solar PV capacities in the Transforming Energy Scenario in 2030 in this report are slightly higher than the estimates presented in IRENA's reports (IRENA, 2019b; 2019c) which consider developments as of the third quarter of 2019.

SOCIO-ECONOMIC OUTLOOK TO 2050

● Sub-Saharan Africa

2019e 2030 2050

	2019e	2030	2050
Population (thousands) region-wide	1 065 761	1 352 421	1 947 326

**GDP (USD 2015)**

	2019e	2030	2050
GDP (million): PES	2 562 424	4 330 057	12 582 520
GDP (million): TES	2 572 269	4 354 122	12 673 559
GDP changes (million): TES vs. PES	9 846	24 065	91 039
GDP changes (%): TES vs. PES	0.4	0.6	0.7
Per capita GDP (thousand): PES	2.4	3.2	6.5
Per capita GDP (thousand): TES	2.4	3.2	6.5

**Employment****Economy-wide employment (thousands)**

	2019e	2030	2050
Employment: PES	280 021	307 757	337 215
Employment: TES	279 997	307 688	337 240
Employment changes: TES vs. PES	-23	-69	25
Employment changes (%): TES vs. PES	-0.01%	-0.02%	0.01%

● Sub-Saharan Africa

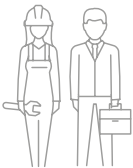


Energy sector jobs (thousands)

	2017	2030 (PES)	2050 (PES)	2030 (TES)	2050 (TES)
Nuclear power	6	3	3	1	2
Fossil fuels	3 122	3 060	2 753	2 929	2 489
Renewables	306	442	519	859	2 023
Energy efficiency	506	758	801	1 217	1 016
Power grids and energy flexibility	313	462	502	462	694
Total	4 253	4 725	4 577	5 468	6 224
Energy jobs in economy-wide employment (%)		1.5%	1.4%	1.8%	1.8%

Renewable energy jobs (thousands)

	2017	2030 (PES)	2050 (PES)	2030 (TES)	2050 (TES)
Bioenergy	176	243	279	581	1 270
Solar	44	97	135	154	583
Hydropower	71	76	64	91	111
Wind	14	25	37	30	57
Geothermal	1	2	3	3	3
Ocean	0	0	0	0	0
Total	306	442	519	859	2 023
Renewable energy jobs in energy-sector employment (%)		9.4%	11.3%	15.7%	32.5%



Job differential in 2050 (thousands) TES vs. PES

Economy-wide	25
Changes in conventional energy (A)	-265
Changes in transition related technologies (B)	191
Net jobs (A+B)	1647

► Jobs in 2050: TES / ● Sub-Saharan Africa

Technology jobs (thousands)		Segment value chain (thousands)		Occupational requirements (thousands)	
Solar PV	257	Construction & installation	380	Workers and technicians	532
Solar water heaters (SWH)	311	Manufacturing	95	Experts	44
Onshore wind	57	Operation and maintenance	153	Engineers and higher degrees	39
Offshore wind	0	Biofuel supply	-	Marketing and administrative	13
Geothermal	3				
Total	628		628		628

Welfare improvement (%):
TES vs. PES

Indicator	2030		2050	
Economic		0.0		0.1
Social		4.2		9.2
Environmental		1.9		4.2
Total		6.2		13.5



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