Regional Savings Assessment

East African Region

LIGHTING

All Lighting

COOLING

Residential Refrigerators

Commercial Refrigeration

Room Air Conditioners

EQUIPMENT

Industrial Electric Motors

Distribution Transformers

INTRODUCTION

This Regional Savings Assessment report provides a summary of the benefits attained from improved energy efficiency and climate friendly lighting, cooling appliances, and equipment for the East African Region. A market transformation can be obtained through measures such as Minimum Energy Performance Standards (MEPS); product labelling; market monitoring and verification; and financial incentives. For each product, the analysis considers three different scenarios:

- **Business As Usual:** Assumes that no actions are introduced and that the efficiency of products in the market continues to develop in line with historical trends in the absence of regulation.
- **Minimum Ambition:** In which MEPS are introduced in line with the basic requirements of the United Nations Environment Programme (UNEP) United for Efficiency (U4E) Model Regulation Guidelines.
- **High Ambition:** In which more stringent MEPS are implemented in line with the highest levels proposed in the guidelines.

This analysis covers the following countries: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania and Uganda. Individual country overview reports and detailed analysis for lighting, cooling and equipment can be found on the UNEP U4E website.

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1 The assumptions for each of these scenarios in each country are detailed on p6 of this report.

Clean Cooling COLLABORATIVE

Department for Environment Food & Rural Affairs

gef

UN environment programme

OVERVIEW OF BENEFITS

ANNUAL SAVINGS IN 2040*

Reduce electricity use in 2040 by **10.9 TWh** which is **16.3 %** of current electricity use contributing to total cumulative savings of **110 TWh** by then.

These electricity savings are worth **1.3 Billion US$** a year in 2040 leading to a total cumulative saving on electricity bills of **11.9 Billion US$** by that year.

The reduction in electricity demand could prevent the need to build **5 power plants [500MW each]** in the region by 2040.

The CO_2 emissions saved from these reductions will be **5 million tonnes** per year by 2040 contributing **48.6 million tonnes** to savings over 17 years.
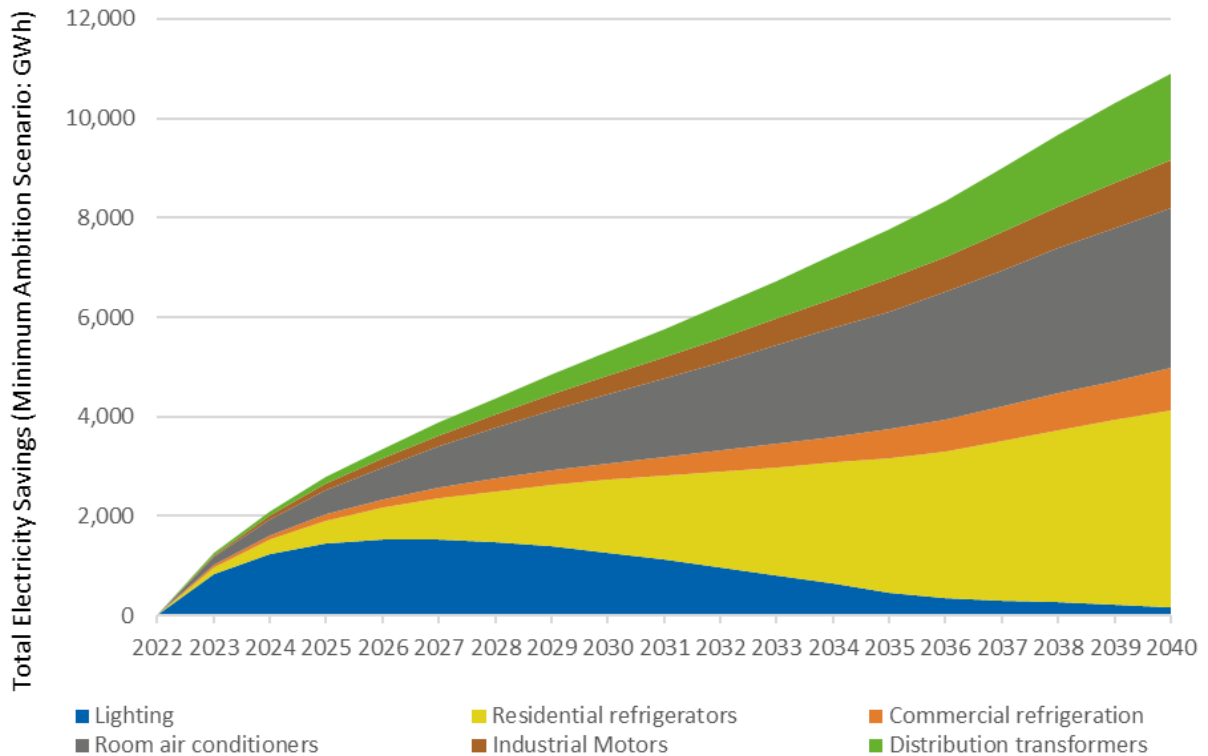
These emissions savings are equivalent to taking **27 million cars** off the road.

More stringent polices in the high ambition scenario increase annual savings to **22 TWh** by 2040 increasing total cumulative savings to **212 TWh** by then.

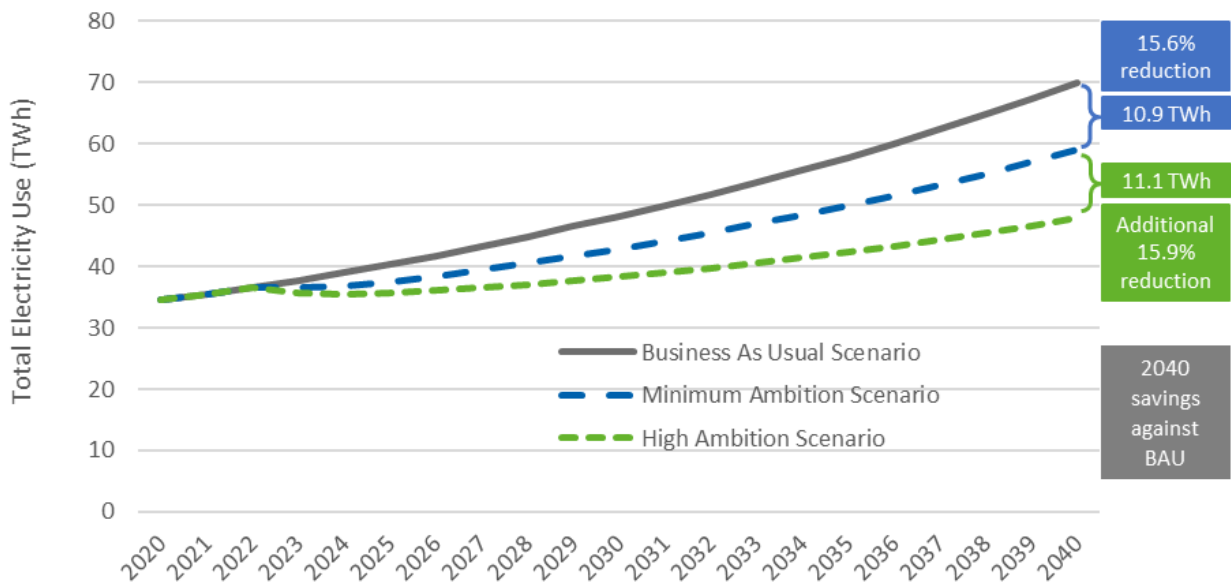## ELECTRICTY SAVINGS OVER TIME TO 2040*

Legend:
- Lighting
- Residential refrigerators
- Commercial refrigeration
- Room air conditioners
- Industrial Motors
- Distribution transformers

* denotes savings are from the Minimum Ambition Scenario

THE POTENTIAL FOR MORE BENEFITS

THE MORE AMBITIOUS THE POLICY, THE MORE ELECTRICITY SAVINGS ARE

Total Electricity Use (TWh) vs Years 2020–2040

- Business As Usual Scenario
- Minimum Ambition Scenario
- High Ambition Scenario

15.6% reduction
10.9 TWh
11.1 TWh
Additional 15.9% reduction
2040 savings against BAU

BRINGING EXTRA SAVINGS OVER TIME IN BOTH CO_2 AND ELECTRICITY BILLS

■ Minimum Ambition Scenario   ■ High Ambition Scenario

Year	CO_2 Min	CO_2 High		Bills Min	Bills High	Year
2023	0.5	0.8		0.1	0.3	2023
2024	0.8	1.4		0.2	0.4	2024
2025	1.1	1.9		0.3	0.5	2025
2026	1.3	2.4		0.3	0.6	2026
2027	1.6	2.9		0.4	0.7	2027
2028	1.8	3.3		0.4	0.8	2028
2029	2	3.8		0.5	0.9	2029
2030	2.3	4.3		0.6	1.0	2030
2031	2.5	4.8		0.6	1.2	2031
2032	2.7	5.3		0.7	1.3	2032
2033	3	5.8		0.7	1.4	2033
2034	3.3	6.4		0.8	1.6	2034
2035	3.5	7.0		0.9	1.7	2035
2036	3.8	7.6		0.9	1.9	2036
2037	4.1	8.2		1.0	2.0	2037
2038	4.4	8.9		1.1	2.2	2038
2039	4.8	9.5		1.2	2.3	2039
2040	5	10.1		1.3	2.6	2040

Cumulative savings: 49 Million tonnes of CO2 | 94 Million tonnes of CO2 | 12 Billion US$ | 23 Billion US$
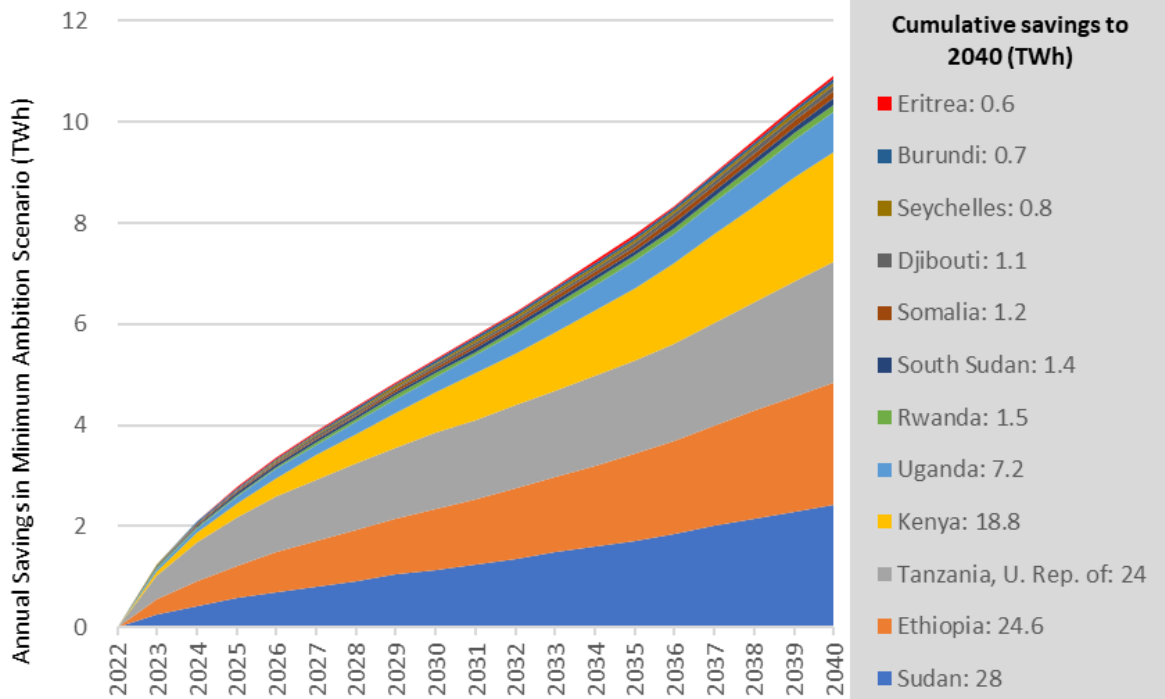
AND OTHER SOCIETAL BENEFITS IN 2040 BY SCENARIO**

Increased grid connection to between **5.0 – 9.7 Million households**

Reduced cumulative direct GHG emissions by **9.2 Million tonnes**

** denotes a range of savings are shown from the Minimum Ambition to the High Ambition Scenario

THE SHARE OF ELECTRICTY SAVINGS TO 2040 VARIES BY COUNTRY*

Cumulative savings to 2040 (TWh)

- Eritrea: 0.6
- Burundi: 0.7
- Seychelles: 0.8
- Djibouti: 1.1
- Somalia: 1.2
- South Sudan: 1.4
- Rwanda: 1.5
- Uganda: 7.2
- Kenya: 18.8
- Tanzania, U. Rep. of: 24
- Ethiopia: 24.6
- Sudan: 28

AND ACCUMULATES OVER TIME*

	Annual savings in 2040			Cumulative savings by 2040		
	Electricity	Electricity Bills	CO2 emissions	Electricity	Electricity Bills	CO2 emissions
	(GWh)	(Million US$)	(Thousand tonnes)	(GWh)	(Million US$)	(Thousand tonnes)
Burundi	71	4	58	733	37	602
Djibouti	107	28	73	1,120	294	762
Eritrea	56	7	54	631	74	611
Ethiopia	2,420	87	134	24,600	884	1,360
Kenya	2,200	477	1,760	18,800	4,090	15,100
Rwanda	144	29	105	1,470	297	1,070
Seychelles	71	23	47	814	261	544
Somalia	125	52	85	1,180	485	799
South Sudan	130	56	85	1,350	582	885
Sudan	2,370	57	638	28,000	673	7,550
Tanzania	2,430	306	1,470	24,000	3,020	14,500
Uganda	788	133	532	7,150	1,210	4,840

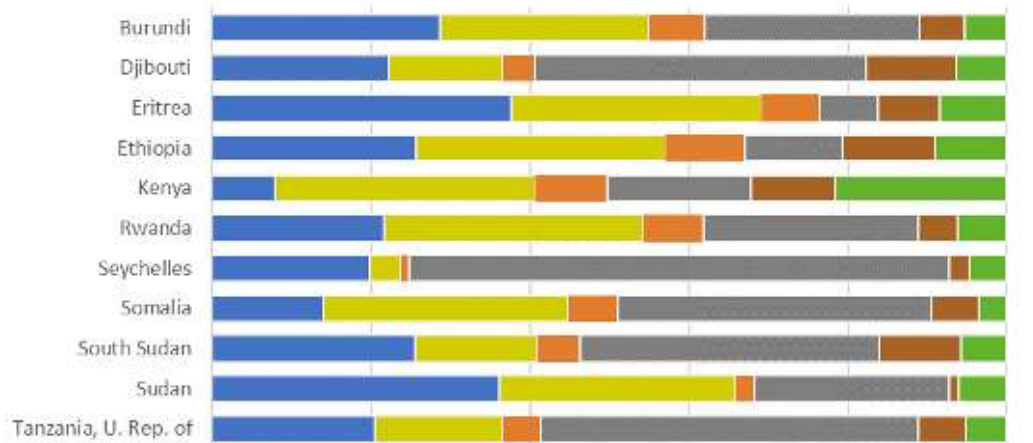* denotes savings are from the Minimum Ambition Scenario

DETAILED BENEFITS BY PRODUCT

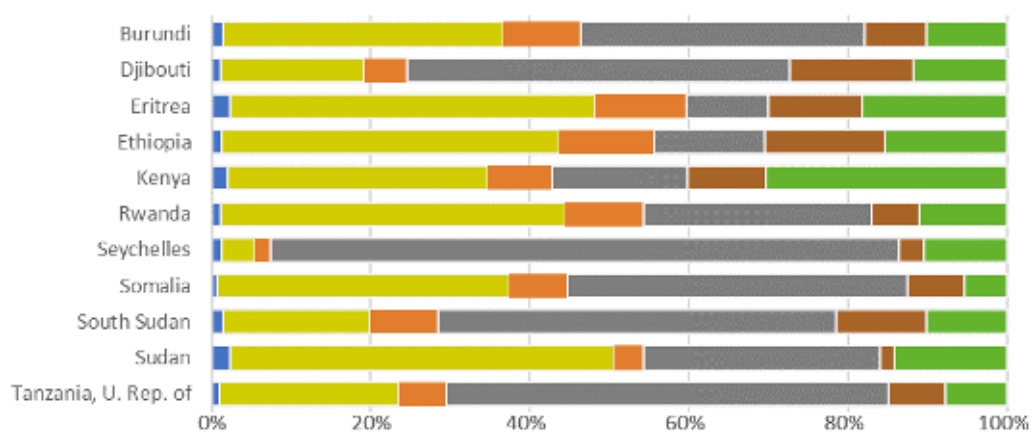## THE SHARE OF SAVINGS IN 2030 ALSO VARIES BY PRODUCT*

	Annual (A) Cumulative (C)	Lighting	Residential Refrigerators	Commercial Refrigeration	Room Air Conditioners	Industrial Electric Motors	Distribution Transformers
Electricity (GWh)	A	1,270	1,460	335	1,400	376	479
	C	10,700	6,110	1,470	6,060	1,660	1,880
Electricity Bills (Million US$)	A	96	143	39	164	47	61
	C	785	598	168	709	205	240
CO_2 emissions (Thousand tonnes)	A	444	596	145	683	167	239
	C	3,680	2,490	632	2,950	735	941

AND THOSE ANNUAL SAVING SHARES VARY BY COUNTRY AND OVER TIME*

* denotes savings are from the Minimum Ambition Scenario

Legend:
- Lighting
- Residential Refrigerators
- Commercial Refrigeration
- Room Air Conditioners
- Industrial Electric Motors
- Distribution Transformers

INPUT ASSUMPTIONS FOR EACH PRODUCT

GENERAL PRODUCT ASSUMPTIONS

	Product		Unit Energy Consumption (UEC: kWh/y) or Efficiency Level (Eff.)			
			Business As Usual	Minimum Ambition Scenario	High Ambition Scenario	Typical product/usage pattern assumed to be:
Lighting (UEC)	GSL		*15W CFL* 15	*10W LED* 10	*7W LED* 7	800 lumen light bulb: 1,000 hrs/year
	Linear		*36W T8* 108	*20W LED* 60	*16W LED* 48	4 foot tube: 3,000 hrs/year
	HID		*70W HPS* 307	*50W LED* 219	*40W LED* 175	Poletop street light: 4,380hrs/year
Cooling (UEC)	Residential Refrigerators		330	247	123	2-door refrigerator freezer of average size 210 litres
	Commercial Refrigeration		3,828	3,427	2,583	A market-weighted average of retail display cabinets (both remote and integral), drinks cabinets, storage cabinets, ice-cream freezers, vending machines and scooping cabinets.
	Room Air Conditioners		3,500	2,406	1,776	A mix of 3.5 kW and 7 kW split units with a weighted-average cooling capacity of 5 kW
Equipment (Eff.)	Industrial Electric Motors		IE0	IE2	IE3	3-phase induction motors used in the industrial sector
	Distribution Transformers		See note	Level 1	Level 2	Three-phase and single-phase liquid-filled and three-phase dry-type power distribution transformers

Distribution transformers Note: it is assumed that distribution transformers have losses in line with those assumed in the CENELEC harmonization research for the development of the EU standards.

COUNTRY SPECIFIC PRODUCT ASSUMPTIONS

As shown below, some country assumptions vary from those listed above for a number of reasons:

1- Local market data provides a more accurate basis for the assumptions used in the BAU scenario for Residential Refrigerators in Sudan and Room Air Conditioners in Rwanda and Sudan.

2- Variations in climate zone lead to different assumptions on hours of use for Room Air Conditioners. This, in turn, leads to different UEC assumptions in the BAU scenario in all countries listed.

3- The baseline motor efficiency assumption for Seychelles is higher in line with the overall approach which higher income countries use more efficient motors.

4- MEPS for lighting in Kenya mean that CFLs are phased out in the Minimum Ambition scenario.

Product	Country	Unit Energy Consumption (kWh/year) or Efficiency Level			
		Business As Usual	Minimum Ambition Scenario	High Ambition Scenario	Average capacity
Residential Refrigerators	Sudan	473	283	142	331 litres
Room Air Conditioners	Burundi	3,011	2,049	1,503	5.0 kW
	Ethiopia	1,431	964	695	5.0 kW
	Kenya	1,431	964	695	5.0 kW
	Rwanda	1,313	964	695	5.0 kW
	Seychelles	4,219	2,786	2,022	5.0 kW
	Somalia	4,219	2,786	2,022	5.0 kW
	Sudan	2,559	1,884	1,429	5.0 kW
	Tanzania, U. Rep. of	3,011	2,049	1,503	5.0 kW
	Uganda	1,431	964	695	5.0 kW
Industrial Electric Motors	Seychelles	IE1	IE2	IE3	Mixed

COUNTRY DATA AND METHODOLOGY

COUNTRY DATA

	Population (million)	GDP Per Capita (US$)
Burundi	12.3	248
Djibouti	1.0	3,577
Eritrea	3.6	644
Ethiopia	117.9	966
Kenya	55.0	1,932
Rwanda	13.3	826
Seychelles	0.1	11,109
Somalia	16.4	454
South Sudan	11.4	1,361
Sudan	44.9	500
Tanzania, U. Rep. of	61.5	1,116
Uganda	47.1	849

ELECTRICITY MARKET

Electrification Level	CO_2 Emissions factor (kg/kWh)	Residential Electricity Tariff (US$/kWh)	Transmission and Distribution loss factor
11.2%	0.62	0.05	25.0%
64.9%	0.62	0.26	9.2%
51.8%	0.84	0.12	12.9%
57.9%	0.05	0.04	18.7%
71.7%	0.66	0.22	17.6%
40.5%	0.66	0.20	9.2%
98.2%	0.62	0.32	7.8%
41.9%	0.62	0.41	9.2%
8.0%	0.62	0.43	5.7%
56.0%	0.23	0.02	14.3%
40.5%	0.51	0.13	15.8%
46.1%	0.61	0.17	9.2%

METHODOLOGY

The analysis uses the UNEP-U4E's Country Savings Assessment Models to estimate the impacts of implementing policies that improve the energy efficiency of each product analysed. Details are available on request but, in summary:

- The cooling analyses for refrigerators, commercial refrigeration and air conditioners use a bottom-up stock model approach combined with market data on typical product performance. Future growth is projected forwards based on established relationships between ownership and other known macroeconomic indicators.
- The lighting analysis uses a bottom-up stock model with market data on typical products to estimate current light demand. This is projected forwards in line with IEA estimates of future buildings electricity use. It is then used with an estimate of future average efficacy to calculate electricity consumption. This efficacy is based on assumptions about future trends in lamp switching and product efficacy in different scenarios.
- The equipment models are both top-down estimates. Motors electricity use is based on its typical relationship to industrial GDP, while distribution transformers are based on the typical capacity required for a total national electricity demand. Electricity use is shared between several typical products and applications based on market data. In both cases, the improvement in average stock efficiency is based on end-of-life stock turnover and new sales.

The savings potential in each scenario assumes Minimum Energy Performance Standards (MEPS) are introduced in 2022 at two different levels of ambition (minimum and high) as shown in the Typical Product Assumptions table above.

Further details of the modelling approach and assumptions are available on the U4E website
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