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# Regional Savings Assessment

# West 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 West 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: Benin, Burkin Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Individual country overview reports for lighting, cooling and equipment can be found on the UNEP U4E website.

## CONTENTS


| | |
|---|---|
| Page 1 | Introduction |
| Page 2 | Overview of benefits |
| Page 3 | The potential for more benefits |
| Page 4 | Detailed benefits by country |
| Page 5 | Detailed benefits by product |
| Page 6 | Input assumptions for each product |
| Page 7 | Country data and methodology |


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

# OVERVIEW OF BENEFITS

## ANNUAL SAVINGS IN 2040*

Reduce electricity use in 2040 by nearly **26 TWh** which is **31 %** of current regional electricity use contributing to total cumulative savings of **248 TWh** by then.

These electricity savings are worth **3.6 Billion US$** a year in 2040 leading to a total cumulative saving on electricity bills of **35.2 Billion US$** by that year.

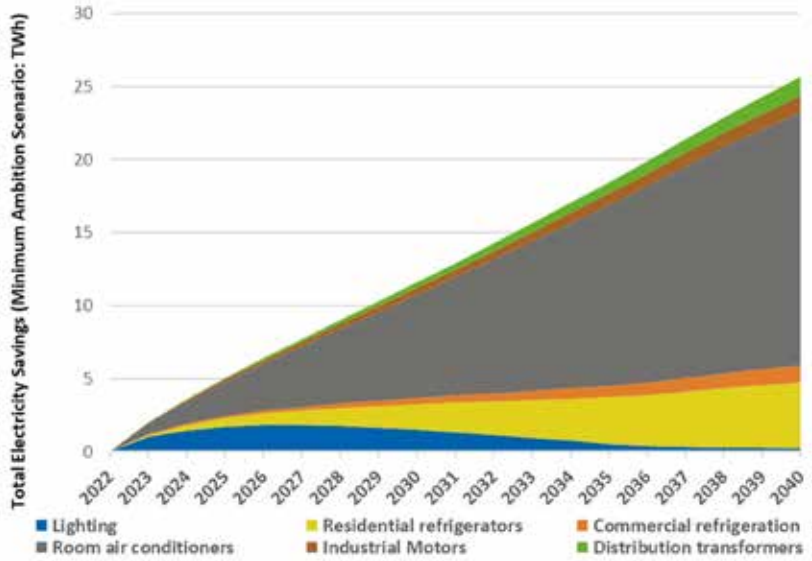
The reduction in electricity demand could prevent the need to build **12 power plants [500MW each]** in the region by 2040.

The $CO_2$ emissions saved from these reductions will be **15.5 million tonnes** per year by 2040 contributing to **150 million tonnes** of savings over 17 years.

These emissions savings are equivalent to taking **nearly 83 million cars** off the road.

More stringent polices in the high ambition scenario increase annual savings to **49 TWh** by 2040 increasing total cumulative savings to **456 TWh** by then.

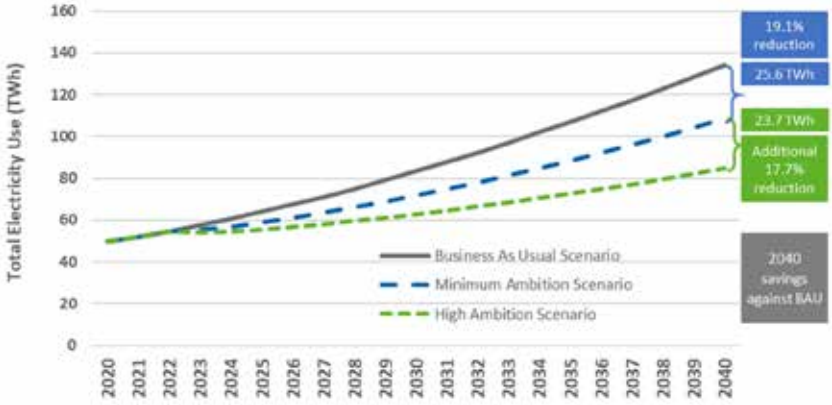
## ELECTRICTY SAVINGS OVER TIME TO 2040*



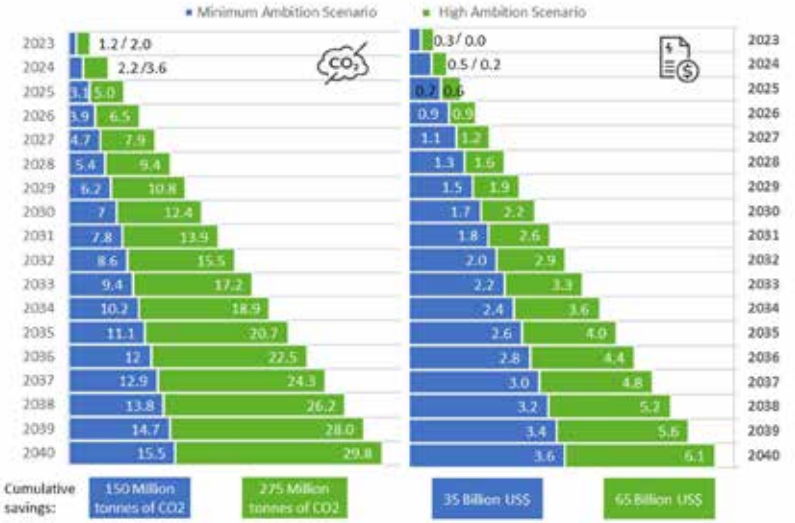

* denotes savings are from the Minimum Ambition Scenario

# THE POTENTIAL FOR MORE BENEFITS

## THE MORE AMBITIOUS THE POLICY, THE MORE ELECTRICITY SAVINGS ARE




## BRINGING EXTRA SAVINGS OVER TIME IN BOTH $CO_2$ AND ELECTRICITY BILLS




## AND OTHER SOCIETAL BENEFITS IN 2040 BY SCENARIO**

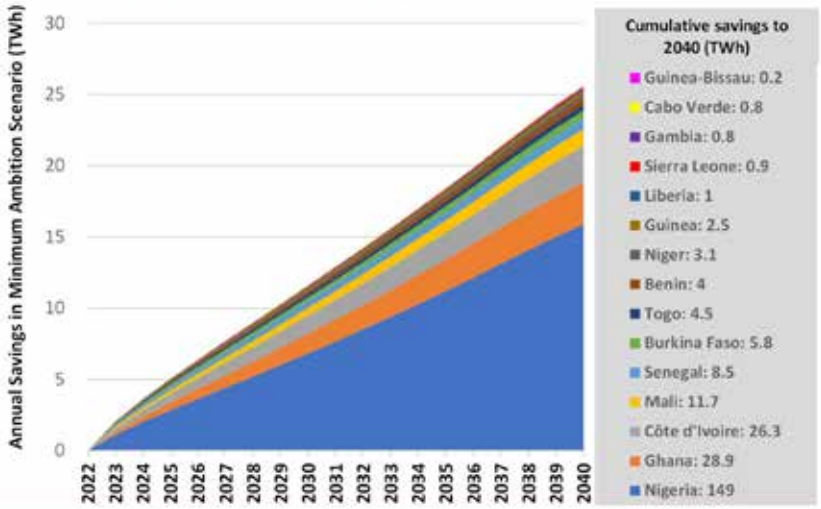
Increased grid connection to between **12 – 23 Million households**

Reduced cumulative direct GHG emissions by nearly **17 Million tonnes**

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

# DETAILED BENEFITS BY COUNTRY

## THE SHARE OF ELECTRICTY SAVINGS TO 2040 VARIES BY COUNTRY*




## AND ACCUMULATES OVER TIME*

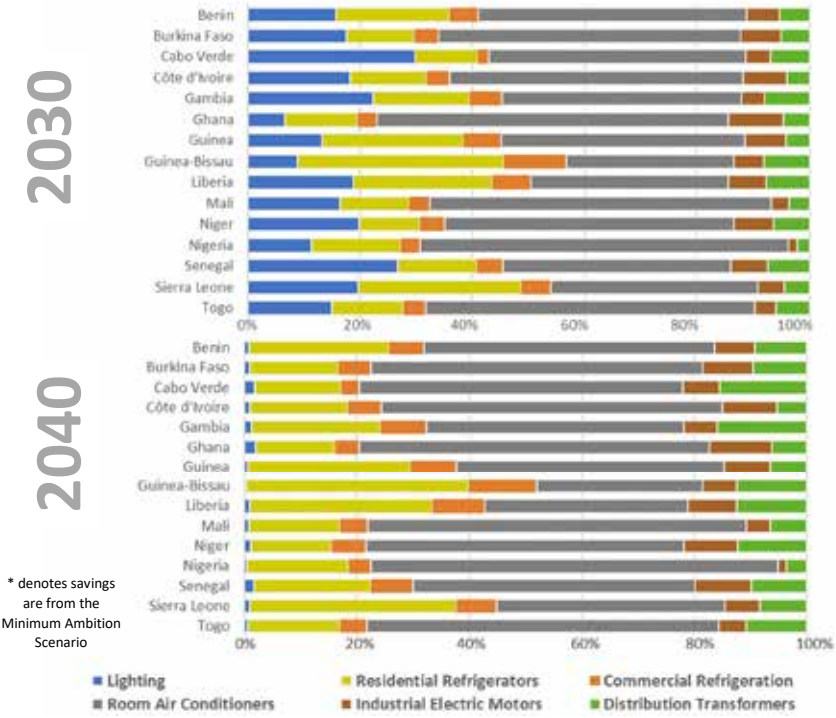
| Denotes Savings for Minimum Ambition Scenario | Annual savings in 2040 | | | Cumulative savings by 2040 | | |
|---|---|---|---|---|---|---|
| | Electricity | Electricity Bills | $CO_2$ emissions | Electricity | Electricity Bills | $CO_2$ emissions |
| **Country** | **(GWh)** | **(Million US$)** | **(Thousand tonnes)** | **(GWh)** | **(Million US$)** | **(Thousand tonnes)** |
| Benin | 404 | 83 | 320 | 3,970 | 818 | 3,150 |
| Burkina Faso | 565 | 135 | 182 | 5,780 | 1,380 | 1,860 |
| Cabo Verde | 68 | 18 | 37 | 783 | 206 | 422 |
| Côte d'Ivoire | 2,570 | 324 | 1,290 | 26,300 | 3,310 | 13,200 |
| Gambia | 77 | 16 | 42 | 824 | 166 | 444 |
| Ghana | 2,940 | 695 | 957 | 28,900 | 6,820 | 9,400 |
| Guinea | 261 | 53 | 141 | 2,470 | 501 | 1,330 |
| Guinea-Bissau | 20 | 5 | 11 | 182 | 50 | 98 |
| Liberia | 101 | 39 | 55 | 1,020 | 397 | 549 |
| Mali | 1,160 | 165 | 825 | 11,700 | 1,660 | 8,320 |
| Niger | 294 | 63 | 247 | 3,070 | 653 | 2,580 |
| Nigeria | 15,900 | 1,780 | 10,400 | 149,000 | 16,700 | 97,800 |
| Senegal | 742 | 135 | 578 | 8,520 | 1,550 | 6,640 |
| Sierra Leone | 92 | 17 | 60 | 947 | 171 | 614 |
| Togo | 445 | 78 | 318 | 4,490 | 790 | 3,210 |

# 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 | 1,510 | 1,750 | 429 | 7,080 | 454 | 390 |
| | C | 12,700 | 7,420 | 1,840 | 30,200 | 2,010 | 1,590 |
| Electricity Bills (Million US$) | A | 216 | 247 | 247 | 989 | 79 | 62 |
| | C | 1,800 | 1,050 | 1,050 | 4,250 | 349 | 255 |
| $CO_2$ emissions (Thousand tonnes) | A | 932 | 1,070 | 1,070 | 4,270 | 239 | 229 |
| | C | 7,920 | 4,520 | 4,520 | 18,200 | 1,050 | 929 |

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




* denotes savings are from the Minimum Ambition Scenario

# 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 | 3,792 | 3,398 | 2,564 | 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 | 4219 | 2786 | 2022 | 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 several reasons:

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.

| Product | Country | Unit Energy Consumption (kWh/year) or Efficiency Level: Business As Usual | Minimum Ambition Scenario | High Ambition Scenario | Average capacity |
|---|---|---|---|---|---|
| Room Air Conditioners | Burkina Faso | 3,500 | 2,406 | 1,776 | 5.0 kW |
| | Cabo Verde | 2,776 | 1,844 | 1,369 | 5.0 kW |
| | Ghana | 3,500 | 2,406 | 1,776 | 5.0 kW |
| | Guinea-Bissau | 3,011 | 2,049 | 1,503 | 5.0 kW |
| | Liberia | 3,011 | 2,049 | 1,503 | 5.0 kW |
| | Niger | 3,500 | 2,406 | 1,776 | 5.0 kW |
| | Senegal | 2,776 | 1,844 | 1,369 | 5.0 kW |
| | Sierra Leone | 3,011 | 2,049 | 1,503 | 5.0 kW |

Note:
*Ghana has existing MEPS for all products covered in the Minimum ambition Scenario so some CFL lamps are also phased out in that scenario of the analysis.*

# COUNTRY DATA AND METHODOLOGY

## COUNTRY DATA

## ELECTRICITY MARKET

| | Population (million) | GDP Per Capita (US$) | Electrification Level | $CO_2$ Emissions factor (kg/kWh) | Residential Electricity Tariff (US$/kWh) | Transmission and Distribution loss factor |
|---|---|---|---|---|---|---|
| Benin | 12.5 | 1,321 | 46.5% | 0.72 | 0.21 | 9.2% |
| Burkina Faso | 21.5 | 884 | 23.4% | 0.28 | 0.24 | 13.4% |
| Cabo Verde | 0.6 | 3,159 | 96.3% | 0.49 | 0.26 | 9.2% |
| Côte d'Ivoire | 27.1 | 2,465 | 74.2% | 0.43 | 0.13 | 14.3% |
| Gambia | 2.5 | 797 | 62.4% | 0.49 | 0.20 | 9.2% |
| Ghana | 31.7 | 2,287 | 85.4% | 0.25 | 0.24 | 22.6% |
| Guinea | 13.5 | 1,271 | 56.6% | 0.49 | 0.20 | 9.2% |
| Guinea-Bissau | 2.0 | 750 | 33.1% | 0.49 | 0.27 | 9.2% |
| Liberia | 5.2 | 665 | 30.8% | 0.49 | 0.39 | 9.2% |
| Mali | 20.9 | 888 | 50.4% | 0.65 | 0.14 | 9.2% |
| Niger | 25.1 | 579 | 21.0% | 0.49 | 0.21 | 41.8% |
| Nigeria | 211.4 | 2,165 | 58.0% | 0.55 | 0.11 | 16.1% |
| Senegal | 17.2 | 1,510 | 74.1% | 0.68 | 0.18 | 12.9% |
| Sierra Leone | 8.1 | 525 | 24.4% | 0.40 | 0.18 | 38.0% |
| Togo | 8.5 | 944 | 56.9% | 0.21 | 0.18 | 71.0% |

## 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.
For more information contact: unep-u4e@un.org

# REGIONAL SAVINGS ASSESSMENT

## WEST AFRICAN REGION

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