

Bhutan



LIGHTING



All Lighting

COOLING



Residential Refrigerators



Commercial Refrigeration



Room Air Conditioners

EQUIPMENT



Industrial Electric Motors



Distribution Transformers

INTRODUCTION

The Country Savings assessments provide a summary of the benefits attained from improved energy efficiency and climate friendly lighting, cooling appliances, and equipment. 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 ambitious actions are implemented in line with the highest levels proposed in the Model Regulation Guidelines.

More detailed breakdowns for lighting, cooling appliances and equipment can be found on the [UNEP U4E website](#).

REPORT CONTENTS

Page 1	Introduction
Page 2	Overview of benefits
Page 3	Higher ambition to help reach energy and climate goals
Page 4	Detailed benefits and typical product assumptions
Page 5	Savings potential in context
Page 6	Country data, product assumptions and methodology



OVERVIEW OF BENEFITS



ANNUAL SAVINGS IN 2040*



Reduce electricity use by over **94 GWh**

which is over **3.6%** of the total current national electricity use



Save electricity worth over **3.3 million US\$**

equivalent to more than

1 power plant [20MW each]



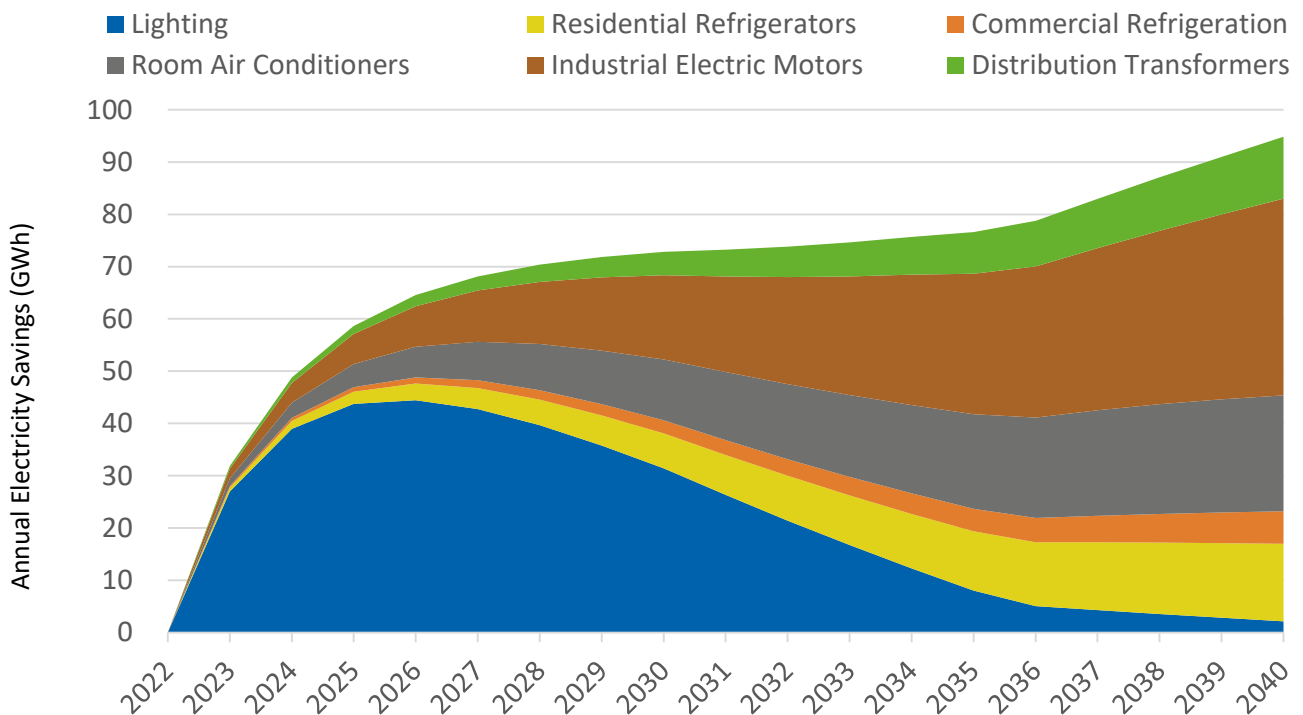
Reduce electricity CO₂ emissions by over **140 thousand tonnes**

equivalent to over

80 thousand passenger cars



ELECTRICITY SAVINGS OVER TIME*



OTHER BENEFITS ACHIEVED IN 2040*



Reduced cumulative direct GHG emissions by **140 thousand tonnes**

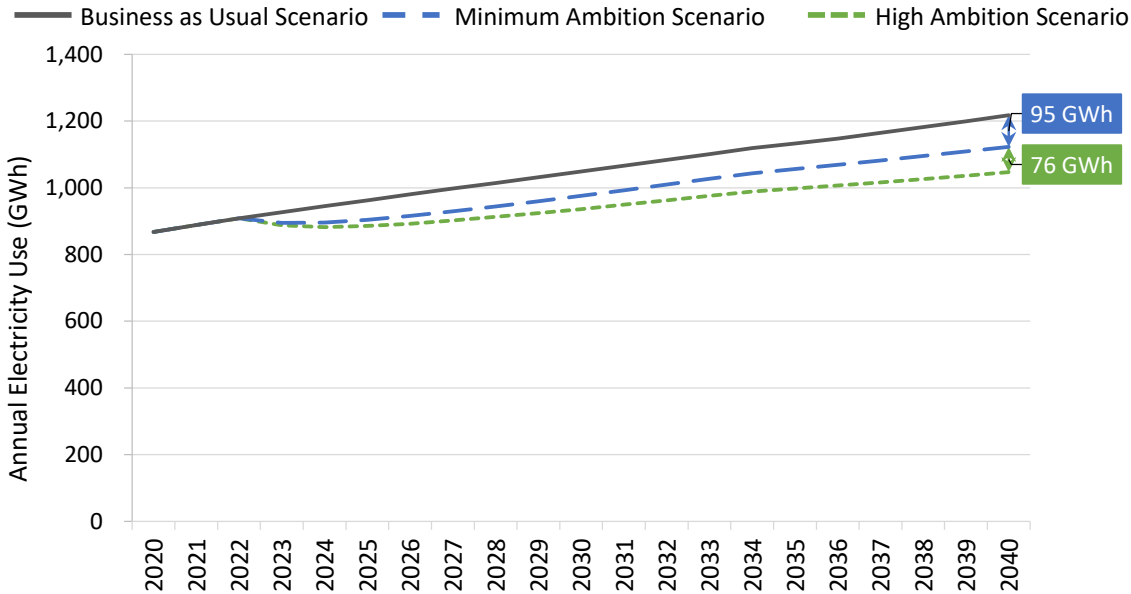
* Savings based on Minimum Ambition Scenario



HIGHER AMBITION TO HELP REACH ENERGY AND CLIMATE GOALS



THE MORE AMBITIOUS THE REGULATION, THE MORE SAVINGS ARE POSSIBLE

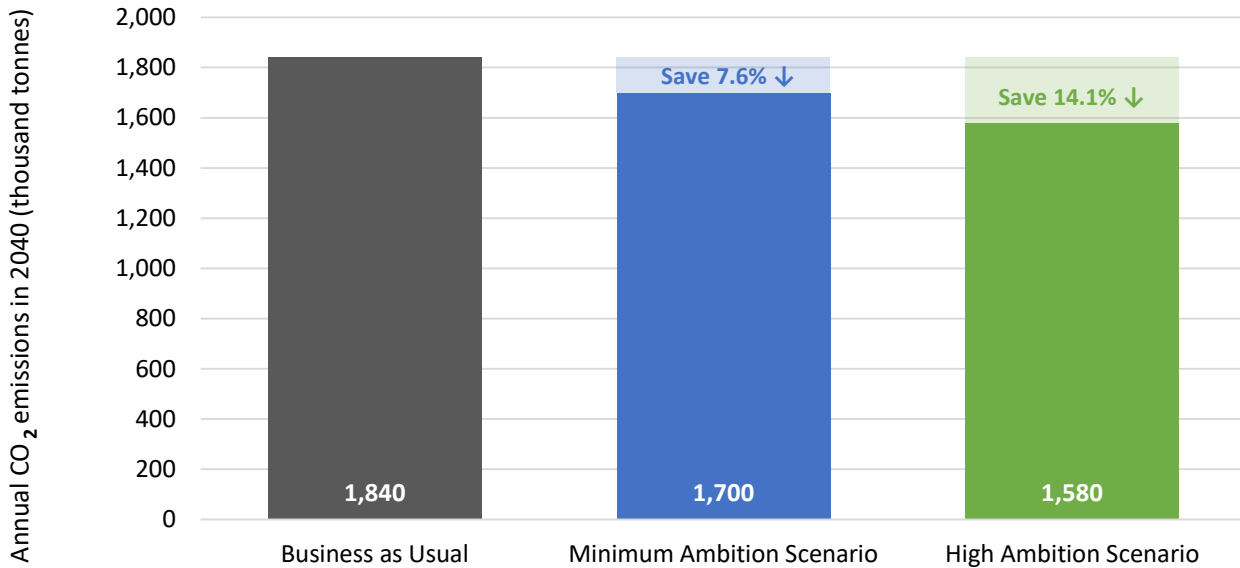


By 2040, electricity consumption is projected to increase by **34%**

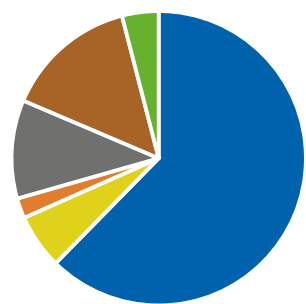
Minimum ambition policies could reduce this increase to **24%**

More ambitious policies could further reduce this increase to **15%**

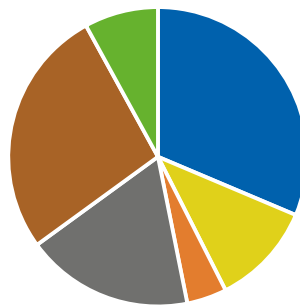
MEET GLOBAL CLIMATE GOALS BY SIGNIFICANTLY DECREASING EMISSIONS



PRODUCT SHARE OF CO₂ EMISSIONS SAVINGS BY 2030 AND 2040*



Share of 0.7 million tonnes of savings by 2030



Share of 2 million tonnes of savings by 2040

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

* Savings based on Minimum Ambition Scenario

DETAILED BENEFITS AND TYPICAL PRODUCT ASSUMPTIONS



ANNUAL SAVINGS IN 2030 AND 2040*

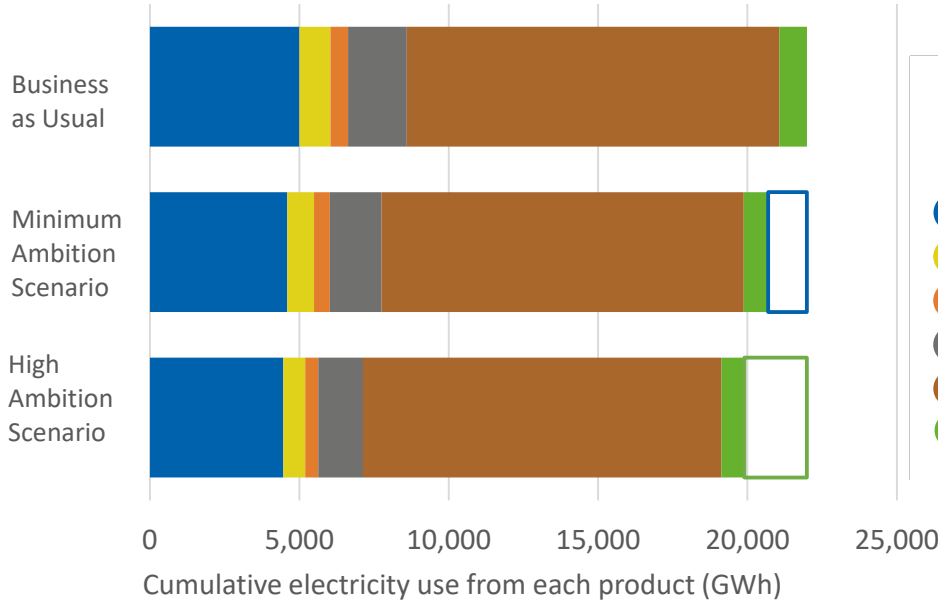
	2030	2040	2030	2040	2030	2040
Cooling		Residential Refrigerators		Commercial Refrigeration		Room Air Conditioners
Electricity (GWh)	6.7	15	2.5	6.2	12	22
Electricity Bills (thousand US\$)	230	520	87	220	410	780
CO2 Emissions (thousand tonnes)	10	22	3.8	9.4	18	34
Lighting and Equipment		Lighting		Industrial Electric Motors		Distribution Transformers
Electricity (GWh)	31	2.2	16	38	4.5	12
Electricity Bills (thousand US\$)	1,100	75	560	1,300	160	410
CO2 Emissions (thousand tonnes)	47	3.3	24	57	6.8	18

CUMULATIVE SAVINGS BY 2030 AND 2040*

	2030	2040	2030	2040	2030	2040
Cooling		Residential Refrigerators		Commercial Refrigeration		Room Air Conditioners
Electricity (GWh)	29	140	11	56	53	230
Electricity Bills (million US\$)	1.0	5.1	0.4	2.0	1.8	8.2
CO2 Emissions (thousand tonnes)	44	220	16	84	80	350
Lighting and Equipment		Lighting		Industrial Electric Motors		Distribution Transformers
Electricity (GWh)	300	410	71	350	20	100
Electricity Bills (million US\$)	11	14	2.5	12	0.7	3.6
CO2 Emissions (thousand tonnes)	460	610	110	530	30	160

PRODUCT CONTRIBUTION TO CUMULATIVE ELECTRICITY USE & SAVINGS BY 2040

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



Savings share by 2040:	
Minimum Ambition	High Ambition
31%	26%
11%	15%
4%	7%
18%	23%
27%	22%
8%	8%

* Savings based on Minimum Ambition Scenario

SAVINGS POTENTIAL IN CONTEXT

OTHER OPPORTUNITIES COMPARED WITH MEPS BY 2040

Minimum Energy Performance Standards are developed specifically to improve product efficiency in a market, but other important steps can be taken reduce electricity consumption further.

ROOM AIR CONDITIONERS	Savings compared	
<ul style="list-style-type: none"> Ensuring products are correctly sized at the time of installation Implementing best practice ongoing maintenance practices Raising the temperature set point for MEPS-compliant units from 22°C can save between 6-10% per degree up to 27°C The use of control systems, sensors and thermal zoning. The savings from AC controls varies greatly depending on the situation but typical savings can be: <ul style="list-style-type: none"> 28-35% for small offices 32-35% for small retail 24% for supermarkets 	U4E MEPS, depending on stringency, will reduce national electricity use by	12%-24%
	Increasing the temperature set point saves	6%-10%/°C
	In suitable applications, controls can typically save	24%-35%

LIGHTING	Savings	Compared
<ul style="list-style-type: none"> Occupancy & daylight sensors used in all appropriate settings can typically save up to: <ul style="list-style-type: none"> 40% in commercial settings 30% in industrial settings Dimming controls at off-peak times can typically save as much as: <ul style="list-style-type: none"> 25% for street lighting 	<p>which, by 2040, could save up to:</p> <p>25.4 GWh/y</p> <p>9.1 GWh/y</p> <p>13.1 GWh/y</p>	<p>U4E MEPS, in the minimum and high ambition scenarios, will reduce national electricity use by</p> <p>8%-11%</p> <p>In suitable applications, controls can typically save</p> <p>25%-40%</p>

INDUSTRIAL ELECTRIC MOTORS	Savings	Compared
<ul style="list-style-type: none"> The use of Variable Speed drives in all suitable applications could give an average saving of as much as: <ul style="list-style-type: none"> 20% when used with pumps 20% when used with fans/blowers 10% when used with compressors 5% when used in mechanical applications 	<p>which, by 2040, could save up to:</p> <p>6.7 GWh/y</p> <p>9 GWh/y</p> <p>9.2 GWh/y</p> <p>0.7 GWh/y</p>	<p>U4E MEPS, in the minimum and high ambition scenarios, will reduce national electricity use by</p> <p>2.8%-3.7%</p> <p>In suitable applications, VSDs can typically save</p> <p>5%-20%</p>

DISTRIBUTION TRANSFORMERS SMART GRIDS

The main savings opportunities for distribution transformers come from management practices such as:

- Ensuring transformers are correctly sized at the time of installation
- Implementing best practice ongoing maintenance and rewinding methods

Using Smart Grids brings other benefits including:

- Reducing projected increases in peak demand by as much as 24%, allowing:
 - reduced capacity overall
 - delays in maintenance/replacement requirements
 - reduced CO₂ emissions from peaking plant
- Allowing improved integration of distributed and renewable generation, and more electric cars both with associated CO₂ emissions benefits

COUNTRY DATA, TYPICAL PRODUCT ASSUMPTIONS AND METHODOLOGY



GENERAL INFORMATION

Population	780 Thousand
GDP per capita	3,167 US\$
Electrification level	100.0%
CO ₂ emission factor	1.21 kg/kWh

ELECTRICITY MARKET

Residential electricity tariff	0.04 US\$/kWh
Transmission and distribution loss factor	19.8%

TYPICAL PRODUCT ASSUMPTIONS

		2022 Unit Energy Consumption (kWh/year) or Efficiency Level				
Product		Business As Usual	Minimum Ambition Scenario	High Ambition Scenario	Type of Product	
Lighting	<i>GSL</i>	15W CFL 15	10W LED 10	7W LED 7	800 lumen bulb: 1,000 hrs/year	
	<i>Linear</i>	36W T8 108	20W LED 60	16W LED 48	4 foot tube: 3,000 hrs/year	
	<i>HID</i>	70W HPS 307	50W LED 219	40W LED 175	Poletop street light: 4,380hrs/year	
Cooling	Residential Refrigerators	244	187	122	2-door refrigerator freezer of average size 216 liters	
	Commercial Refrigeration	4,312	3,704	2,752	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	709	526	386	A mix of 3.5 kW and 7 kW split units with a weighted-average cooling capacity of 4.7 kW	
Equipment	Industrial Electric Motors (IEC level)	<i>IE0</i>	<i>IE2</i>	<i>IE3</i>	3-phase induction motors used in the industrial sector	
	Distribution Transformers (Model regulation level)	<i>See note</i>	<i>Level 1</i>	<i>Level 2</i>	Three-phase and single-phase liquid-filled and three-phase dry-type power distribution transformers	

■ *Cooling Note: The minimum ambition scenario MEPS for refrigerators is set at a higher level than the model regulations because local data suggests existing products are already close to those MEPS.* ■ *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.*

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. The brief methodology is provided below (contact U4E for more information):

- 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 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. The electricity use of motors 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