Regional Savings Assessment
Association of Southeast Asian Nations

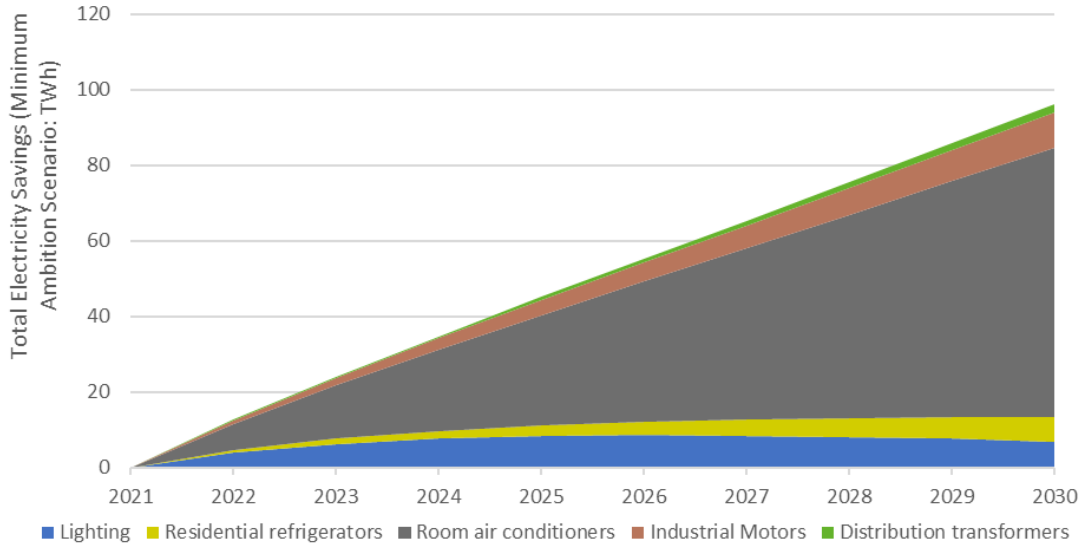
A summary of the potential benefits attained from the implementation of Minimum Energy Performance Standards for lighting, appliances and equipment at a regional level. The impacts are assessed at minimum and high ambition levels[1] as detailed in the Model Regulation Guidelines available from the United Nations Environment Programme (UNEP) United For Efficiency (U4E).

Product Scope	Lighting	Cooling		Equipment	
	All Lighting	Residential Refrigerators	Room Air Conditioners	Industrial Electric Motors	Distribution Transformers

POTENTIAL SAVINGS IN 2030*

	Reduce electricity use by **96.1 TWh** per year which is **9.5 %** of current electricity use which leads to total savings of **495 TWh** by 2030.
	These electricity savings are worth **10.5 Billion US$** a year in 2030 leading to a total saving on electricity bills of **54 Billion US$** by that year.
	The reduction in electricity demand could prevent the need to build **44 power plants [500MW each]** in the region by 2030.
	The CO_2 emissions saved from these reductions will be **67 million tonnes** per year by 2030 contributing **343 million tonnes** to savings over 10 years.
	These emissions savings are equivalent to taking **190 million cars** off the road.
	More stringent polices in the high ambition scenario increase annual savings to **162 TWh** per year which leads to total savings of **823 TWh** by 2030.

ANNUAL SAVINGS BY YEAR TO 2030*

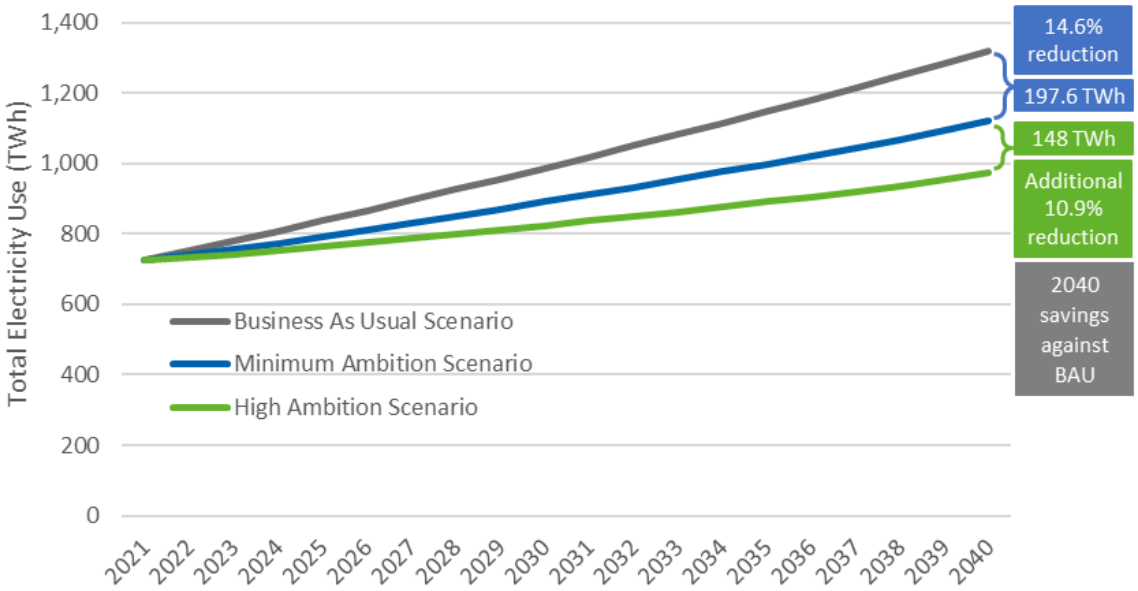


* denotes savings are from the Minimum Ambition Scenario

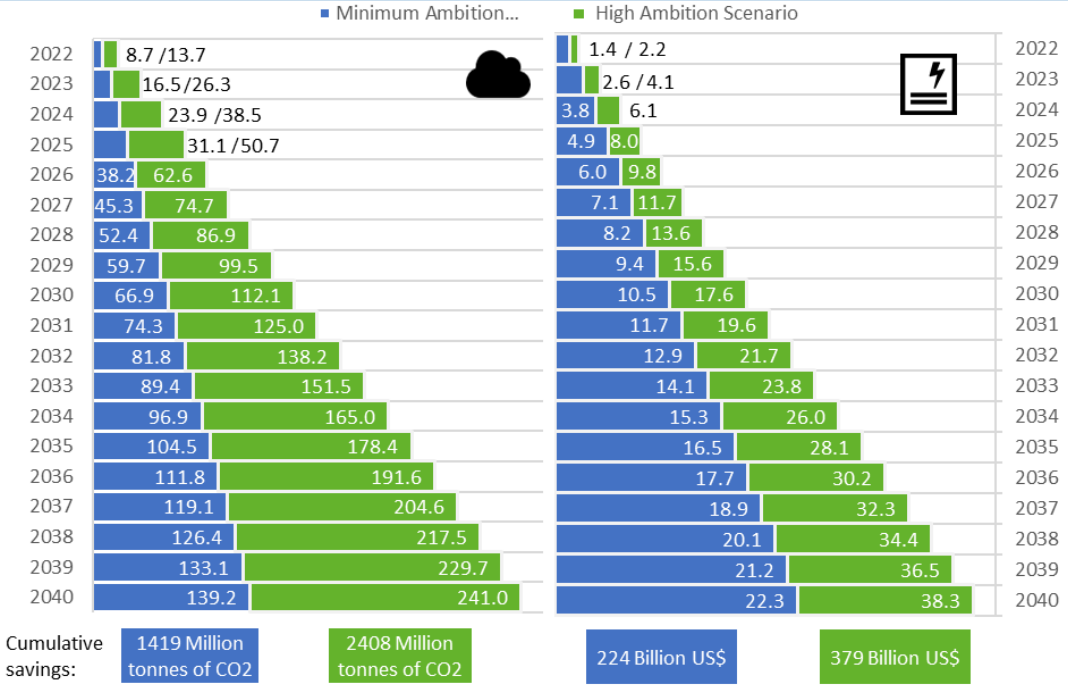
1 The assumptions for each of these scenarios in each country are detailed on p5 of this report.

THE POTENTIAL FOR MORE BENEFITS

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



BRINGING EXTRA SAVINGS OVER TIME IN BOTH CO_2 AND ELECTRICITY BILLS



AND OTHER SOCIETAL BENEFITS IN 2030 BY SCENARIO**

Increased grid connection to between **1.5 – 2.6 Million households**

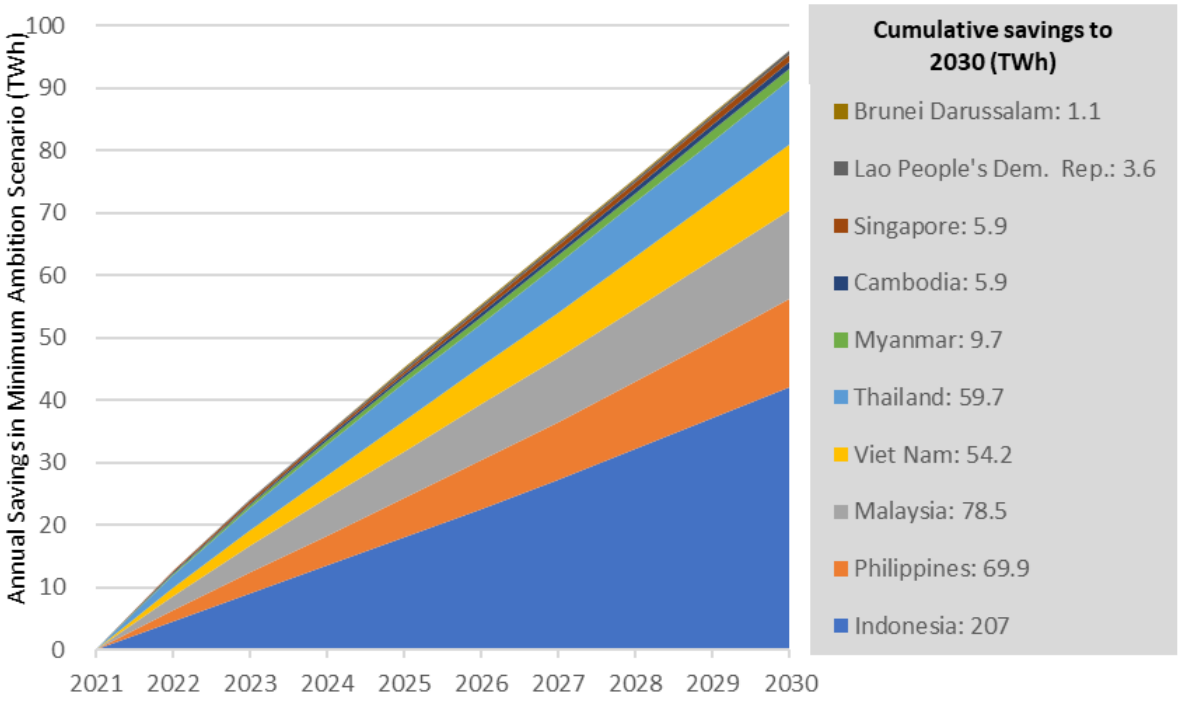
Reduced annual electricity subsidies by between **1.2 – 1.9 Billion US$**

Reduced cumulative direct GHG emissions by **6.7 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 2030 VARIES BY COUNTRY*



AND ACCUMULATES OVER TIME*

	Annual savings in 2030			Cumulative savings by 2030		
	Electricity	Electricity Bills	CO_2 emissions	Electricity	Electricity Bills	CO_2 emissions
	(GWh)	(Million US$)	(Thousand tonnes)	(GWh)	(Million US$)	(Thousand tonnes)
Brunei Darussalam	195	11	155	1,120	64	890
Cambodia	1,200	259	977	5,950	1,290	4,860
Indonesia	42,100	4,210	29,900	207,000	20,700	147,000
Lao People's Dem. Rep.	540	38	322	3,580	250	2,130
Malaysia	14,200	1,090	9,070	78,500	6,060	50,300
Myanmar	1,820	66	547	9,700	349	2,910
Philippines	14,000	2,550	11,800	69,900	12,700	59,000
Singapore	1,070	203	560	5,870	1,110	3,070
Thailand	10,300	1,200	5,920	59,700	6,930	34,200
Viet Nam	10,700	871	7,570	54,200	4,430	38,500

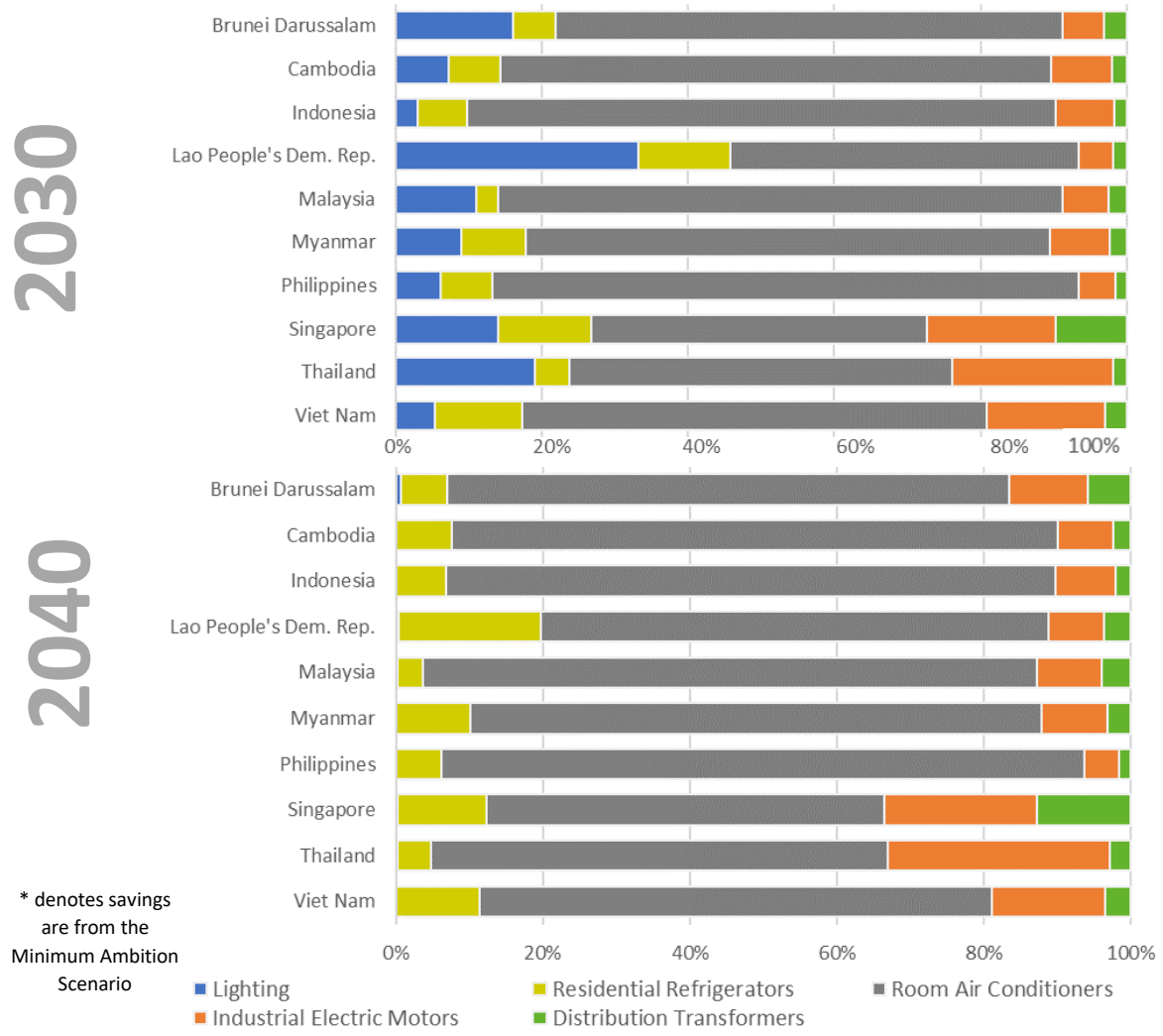
* denotes savings are from the Minimum Ambition Scenario

DETAILED BENEFITS BY PRODUCT

THE SHARE OF SAVINGS IN 2030 ALSO VARIES BY PRODUCT*

	Annual (A) Cumulative (C)	Lighting	Residential Refrigerators	Room Air Conditioners	Industrial Electric Motors	Distribution Transformers
Electricity (GWh)	A	6,780	6,490	71,500	9,430	1,980
	C	65,900	31,400	342,000	46,200	9,290
Electricity Bills (Million US$)	A	740	714	7,840	1,000	213
	C	7,190	3,450	37,300	4,900	1,000
CO_2 emissions (Thousand tonnes)	A	4,450	4,560	50,200	6,330	1,350
	C	43,200	22,000	240,000	31,000	6,330

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	335	259	129	2-door refrigerator freezer of average size 250 litres
	Room Air Conditioners	See below	See below	See below	A mix of 3.5 kW and 7 kW split units with a weighted-average cooling capacity that varies (see below)
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. Thailand's baseline losses are based on local data.

COUNTRY SPECIFIC PRODUCT ASSUMPTIONS

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

1- MEPS for domestic refrigerators and air conditioners in Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam reduce the UEC of those products in the BAU scenario in line with those MEPS.

2- Local market data provides a more accurate basis for the assumptions used in the BAU scenario for all products in a mix of countries.

Product	Country	Unit Energy Consumption (kWh/year) or Efficiency Level			
		Business As Usual	Minimum Ambition Scenario	High Ambition Scenario	Average capacity
Residential Refrigerators	Indonesia	322	240	120	205 litres
	Lao People's Dem. Rep.	325	252	126	230 litres
	Thailand	262	227	113	319 litres
Room Air Conditioners	Brunei Darussalam	3,323	2,426	1,789	4.5 kW
	Cambodia	2,893	2,426	1,789	4.5 kW
	Indonesia	3,063	1,939	1,474	3.7 kW
	Lao People's Dem. Rep.	2,272	2,089	1,571	4 kW
	Malaysia	3,950	2,426	1,789	4.5 kW
	Myanmar	2,493	2,426	1,789	4.5 kW
	Philippines	2,287	1,774	1,367	3.5 kW
	Singapore	2,800	2,465	2,185	5.4 kW
	Thailand	3,455	2,944	2,124	5.2 kW
	Viet Nam	2,863	2,394	1,768	4.2 kW
Industrial Electric Motors	Brunei Darussalam, Malaysia, Singapore, and Viet Nam	IE1	IE2	IE3	Mixed

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
Brunei Darussalam	0.4	27,466	100.0%	0.75	0.06	6.4%
Cambodia	16.7	1,513	75.1%	0.63	0.22	23.4%
Indonesia	273.5	3,870	99.1%	0.64	0.10	9.4%
Lao People's Dem. Rep.	7.3	2,630	96.7%	0.56	0.07	6.2%
Malaysia	32.4	10,402	100.0%	0.60	0.08	5.8%
Myanmar	54.4	1,400	50.1%	0.24	0.04	20.5%
Philippines	109.6	3,299	98.1%	0.77	0.18	9.4%
Singapore	5.9	59,798	100.0%	0.51	0.19	2.0%
Thailand	69.8	7,189	100.0%	0.54	0.12	6.1%
Viet Nam	97.3	2,786	100.0%	0.64	0.08	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 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 above. All analyses are validated against market data (as per below).

ASSUMPTIONS AND DATA SOURCES

- Market size is based on data from industry partners, the UN COMTRADE database and market penetration forecasts generated by U4E Country Savings Assessment Models using data on population, climate, income and other macroeconomic indicators as detailed below.
- Population (2019 and future forecasts) comes from the UN Population Division.
- GDP per capita data (2019) comes from the World Bank with future growth forecasts derived from the IPCC's SSP3 scenario.
- Cooling Degree Days are based on average monthly temperatures from weatherbase.com, degreedays.net or given by wunderground.com.
- Current total electricity consumption comes from the World Bank and the U.S. Energy Information Administration (EIA) with future forecasts derived from the International Energy Agency's (IEA) World Energy Outlook 2018.
- Residential electricity tariffs are based on IEA data.
- Transmission and distribution loss factor is a regional average calculated from electricity production and consumption data published by the IEA.
- Electrification levels come from the IEA's Word Energy Outlook 2019 and ASEAN Energy Database System (AEDS).
- CO_2 emission factors come from the IEA or the Inst. of Global Environmental Strategies (IGES) and are assumed constant in future years.
- Product typical characteristics are based on analysis from the UNEP-U4E Model Regulation Guidelines and other data from UNEP-U4E industry partners and technical experts including the US Lawrence Berkeley National Laboratory (LBNL), the International Copper Association (ICA) and GIZ.
- The approach of calculating direct emissions savings of refrigerators and air conditioners is based on expert input from GIZ and LBNL.
- Additional to the above sources, a questionnaire was used to gather data from country officials.
- In a small number of instances, additional data was obtained from internet research or by using proxy data from similar markets.

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

For more information contact: UNEP: U4E@un.org ACE: REE@aseanenergy.org