U4E Model Regulation Guidelines on Room Air Conditioners

Saikiran Kasamsetty, UNEP-U4E

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National Capacity Building Workshop

Model Regulation Guidelines

- **Simplify adoption** and **implementation** of a robust regulation
- Includes **minimum efficiency** floor and **higher tiers** consistent with technology and market opportunities
- Robust **refrigerant GWP ceiling** for viable, faster action on Kigali Amendment
- Encourage higher performing products through **labelling**
- Vary requirements to capture **climatic differences**
- Over **60+ global technical experts** contributed and referenced **global technology and policy** trends
- Deployed by WorldBank, CLASP, LBNL, IIEC, BASE, NRDC and many others

2019

Translations: English (all), Arabic, Spanish, Chinese, French, Portuguese

Donors: Department for Environment Food & Rural Affairs; Clean Cooling COLLABORATIVE; gef

https://united4efficiency.org/resources/model-regulation-guidelines/

U4E United for Efficiency

U4E Model Regulation Guidelines: Forthcoming

Model Quality & Performance Guidelines for Off-Grid Refrigerating Appliances

U4E Model Regulation Guidelines for Ceiling Fans

U4E Model Regulation Guidelines for Room ACs and Heat Pumps (update of the original version)

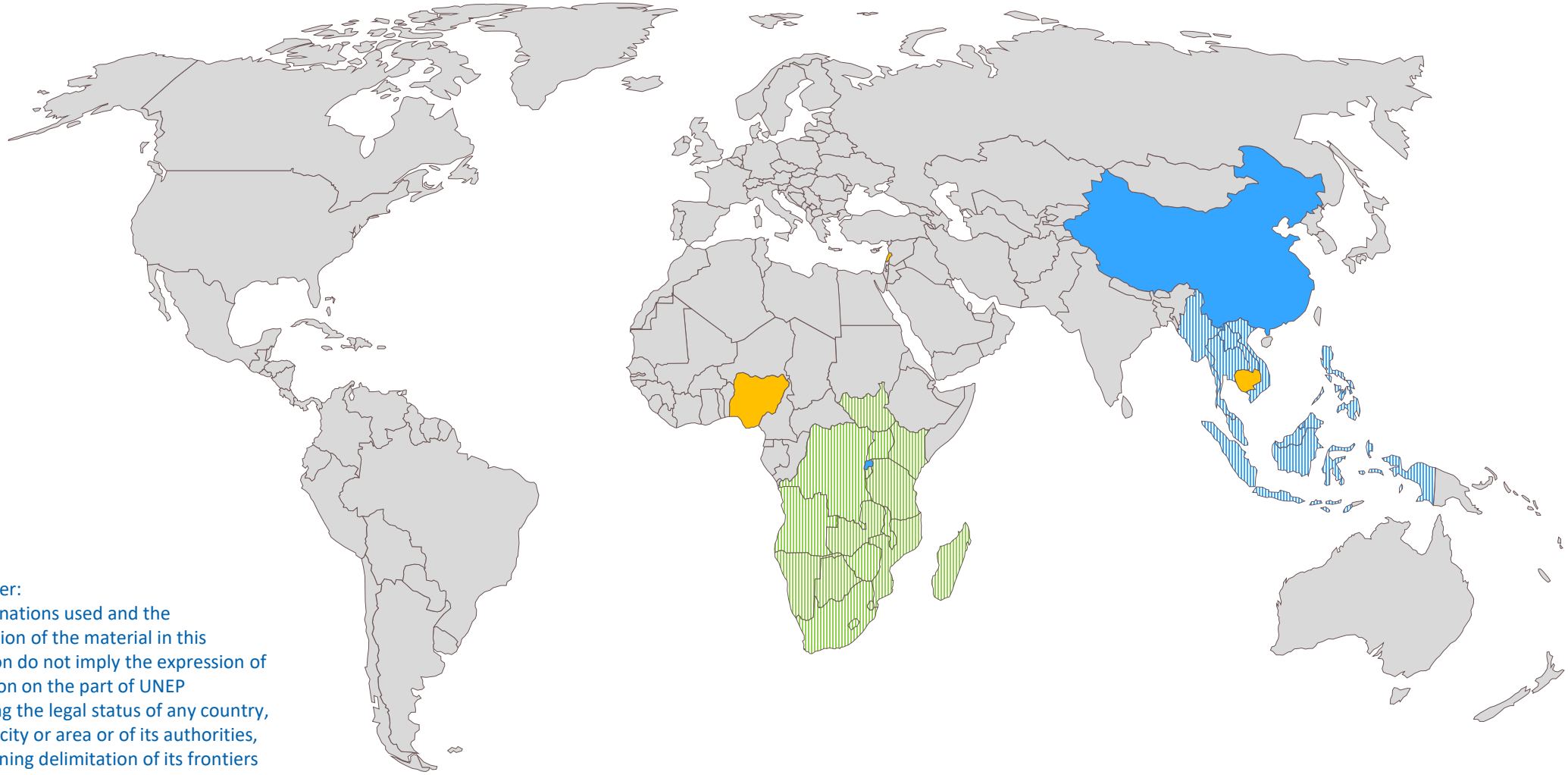
U4E Model Regulation Guidelines for Commercial ACs or Water Heaters (TBC)

2023 — 2024 — 2025

Off Grid Refrigerating Appliances and Ceiling Fans to be released a MOP Energy Efficiency Workshop in October

Continue expand the product scope **heat pumps, water heaters, commercial air conditioners** and/or update or expand existing Model Regulation guidelines**.**

Deployment of U4E Cooling MRGs



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Regional harmonized MEPS for Air conditioners and refrigerators

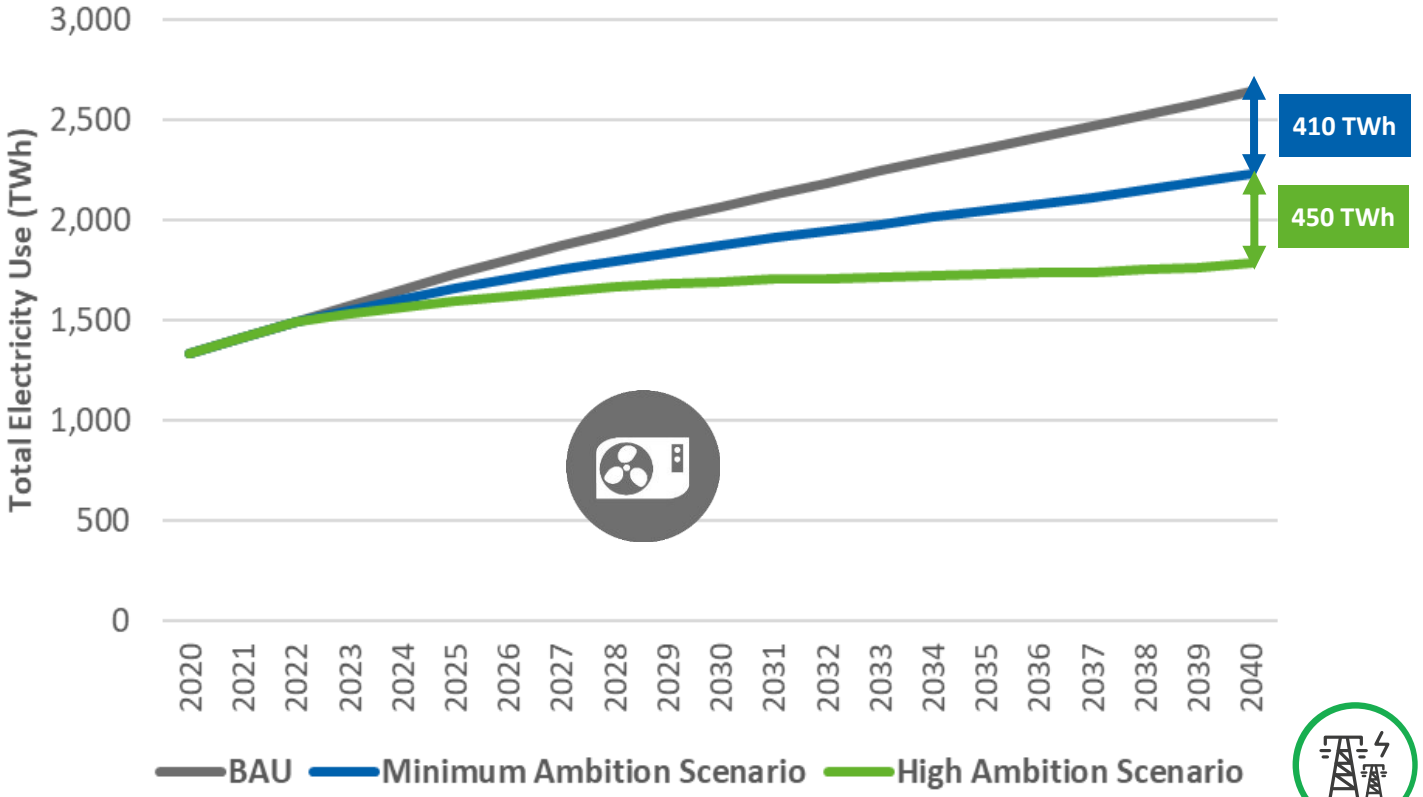
Regional harmonized MEPS for Air conditioners

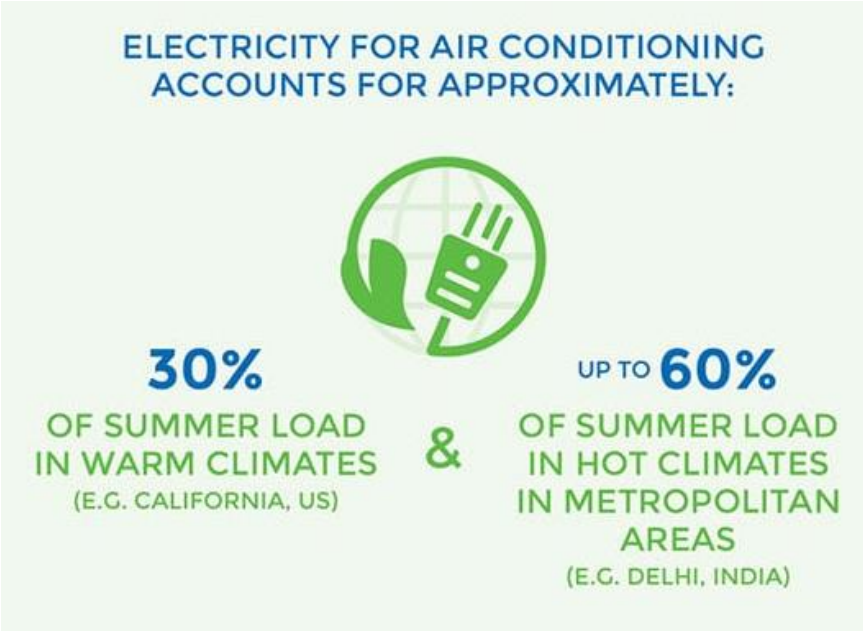
MEPS Agreed (Air conditioners)

High level National Strategy/ Commitment

U4E United for Efficiency

Global electricity savings from energy efficient air conditioners





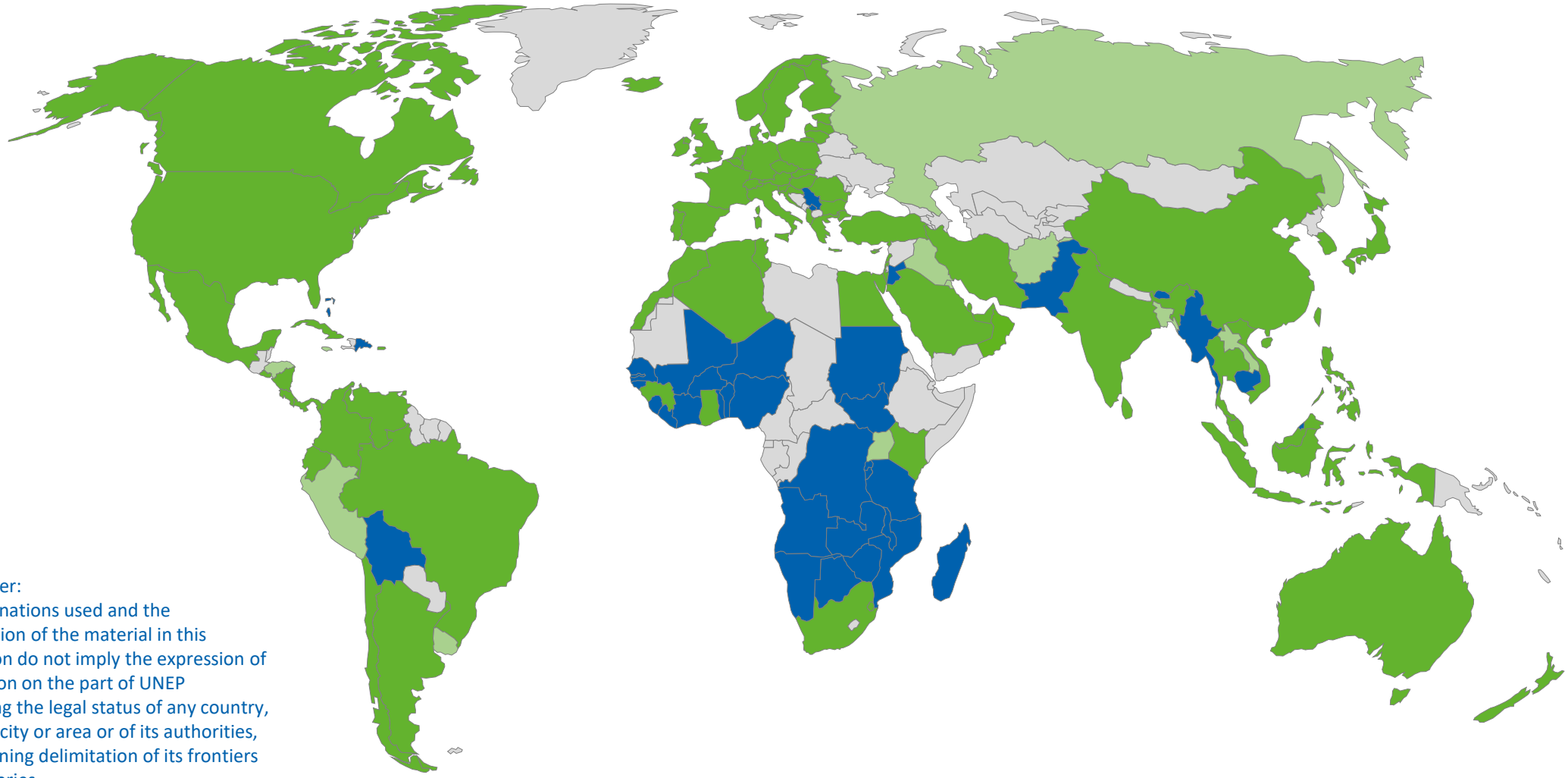
The most efficient air conditioners are 30 percent more efficient than the average products on the market

410	355	$ 61	187
TWh	MtCO2e (54: direct savings)	Billion in electricity bill savings	Power stations [500 MW each]

*Annual savings in 2040 per Minimum Ambition Scenario
U4E Country Savings Assessment (2022)

Resource:https://united4efficiency.org/products/room-air-conditioners/

Global Status of Air Conditioner MEPS Implementation



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Scope of Products – Room Air conditioning appliances

Single Split

Window/ self-contained

Portable

Scope of Products – Room Air conditioning appliances

Covered	Not covered
• Electrical single-phase • Non-ducted single-split • Self-contained • Portable • Air-cooled ACs, air-source HPs • Rated cooling output ≤ 16 kW	• Rated cooling output > 16 kW • Water-cooled ACs, water-source HPs • Multi-split ACs and HPs • Ducted equipment

ACs: air conditioners; HPs: heat pumps

Terms, Test Standards and Metrics

- Terms and definitions are harmonized with those in the reference standards.

	Testing/Rating Standards	Metric
Ductless split & Self-contained	• ISO 16358: 2013 • ISO 5151: 2017	• CSPF (AC) • HSPF (HP) • APF (HP)
Portable	• ISO 18326: 2018 + Amd 1: 2021	• EER (AC) • EER & COP (HP)

CSPF: cooling seasonal performance factor; HSPF: heating seasonal performance factor; APF: annual performance factor
EER: energy efficiency ratio; COP: coefficient of performance

Test Requirements for Cooling (ISO 16358)

Operating condition		Fixed	Two-stage	Multi-stage	Variable
Full capacity and power input	Standard Temperature Outdoor DB 35°C / WB 24°C Indoor DB 27°C / WB 19°C	Required	Required	Required	Required
Half capacity and power input		-[a]	-	Default[c]	Required
Minimum capacity and power input		-	Default[c]	-	-
Full capacity and power input	Low Temperature Outdoor DB 29°C / WB 19°C Indoor DB 27°C / WB 19°C	Default[b]	Default[b]	Default[b]	Default[b]
Half capacity and power input		-	-	Required	Default[b]
Minimum capacity and power input		-	Required	-	-

[a] '-' represents Not applicable or Not considered.

[b] Performance at the lower temperature shall be calculated by using predetermined equations as below:

$Full\ Capacity(29°C) = \text{Full}Capacity(35°C) \times 1.077$; $Full\ Power\ input(29°C) = \text{Full}\ Power\ input(35°C) \times 0.914$

$Half\ Capacity(29°C) = \text{Half}\ Capacity(35°C) \times 1.077$; $Half\ Power\ input(29°C) = \text{Half}\ Power\ input(35°C) \times 0.914$

[c] Performance at the standard temperature shall be calculated by using predetermined equations as below:

$Half\ Capacity(35°C) = \text{Half}\ Capacity(29°C) \div 1.077$; $Half\ Power\ input(35°C) = \text{Half}\ Power\ input(35°C) \div 0.914$

$Min\ Capacity(35°C) = \text{Min}\ Capacity(29°C) \div 1.077$; $Min\ Power\ input(35°C) = \text{Min}\ Power\ input(35°C) \div 0.914$

- For **fixed-speed units**, determine CSPF by **using only one set of test data** at full-capacity operation at 35°C and use another set of data points at 29°C calculated by predetermined equations
- This results in a linear relationship with EER, i.e., CSPF = 1.062 × EER with the ISO reference temperature bin hours.
- For **variable-speed units**, determine CSPF while reducing compliance costs **by using two sets of test data** at full- and half-capacity operation at 35°C and another set of data points at 29°C calculated by predetermined equations, without considering a minimum-capacity operation.

Cooling Seasonal Performance Factor (CSPF)

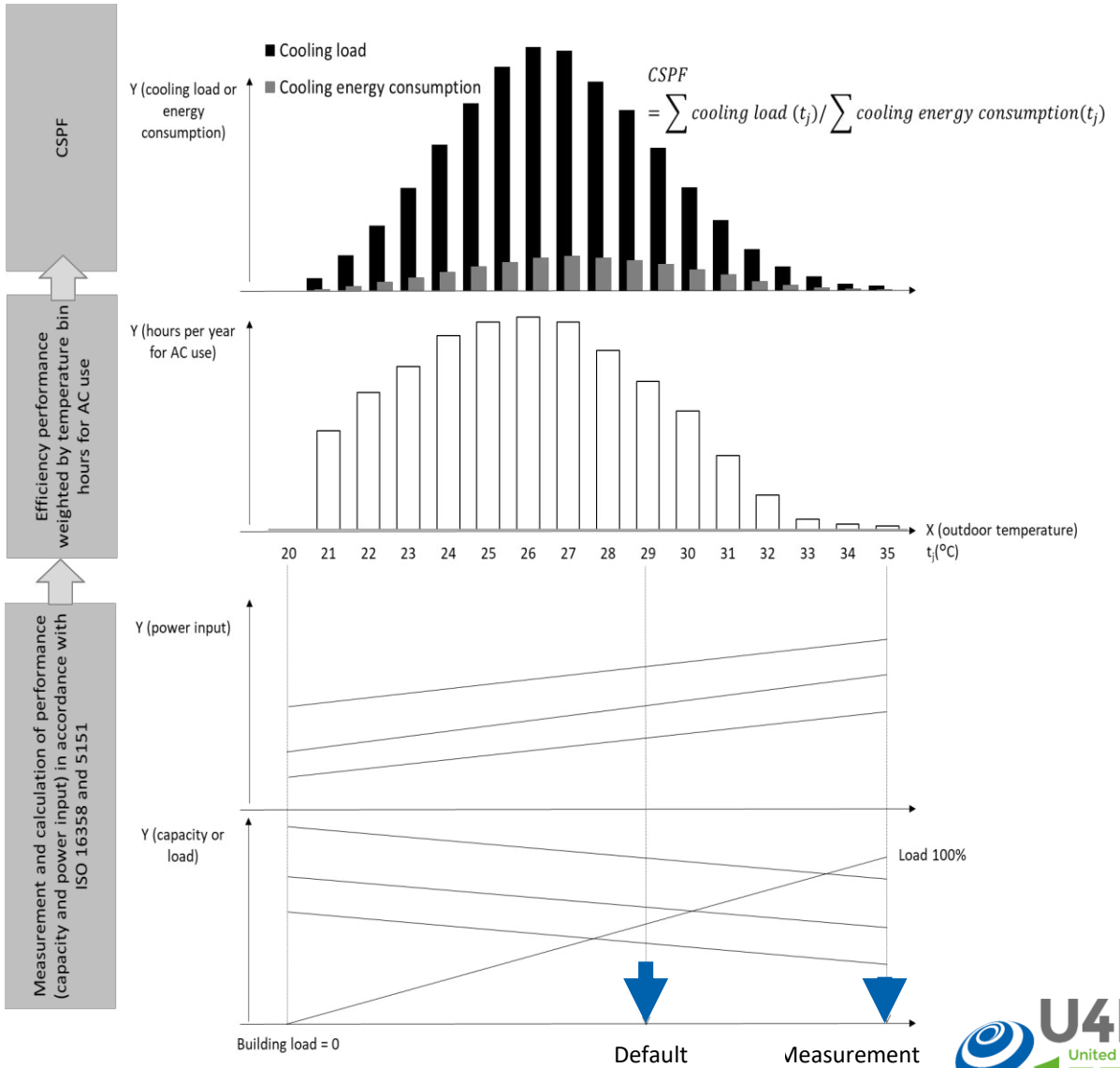
$$F_{CSP}\ (\text{CSPF}) = \frac{L_{CST}\ (CSTL)}{C_{CSE}\ (CSEC)}$$

CSTL: cooling seasonal total load
CSEC: cooling seasonal energy consumption

Parameter	Load 0%	Load 100%
Cooling Load (W)	0	$\emptyset_{ful}(t_{100})$
Outdoor Temperature (°C)	t_0 = 20	t_{100} = 35

Bin number j	1	2	3	4	5	6	7	8	9	10
Outdoor temperature t_j °C	21	22	23	24	25	26	27	28	29	30
Bin hours	100	139	165	196	210	215	210	181	150	120

	11	12	13	14	15	Total
	31	32	33	34	35	-
	75	35	11	6	4	1817



RAC Summary– Energy Performance Evaluation Methods

	Air Conditioners
Category	• Air conditioners, Heat pumps (reversible) • Fixed-speed, variable-speed
Reference Standards	• ISO 5151 • ISO 16358-1, -2, -3: 2013 (Moderate T1 or Hot-Humid) • ISO 16358-1: 2013/Amd 1: 2019 (Hot T3 or Hot-Dry)
Key parameters	• Performance measured at 35˚C (for most climates) • Performance measured at 35˚C and 46˚C (for extremely hot-dry regions) • Outdoor temperature bin hours by ISO 16358 and various climate regions (developed based on ASHRAE definitions)
Efficiency metric	• Cooling Seasonal Performance Factor (CSPF, Wh/Wh) for cooling-only units • Annual Performance Factor (APF, Wh/Wh) for reversible heat pumps

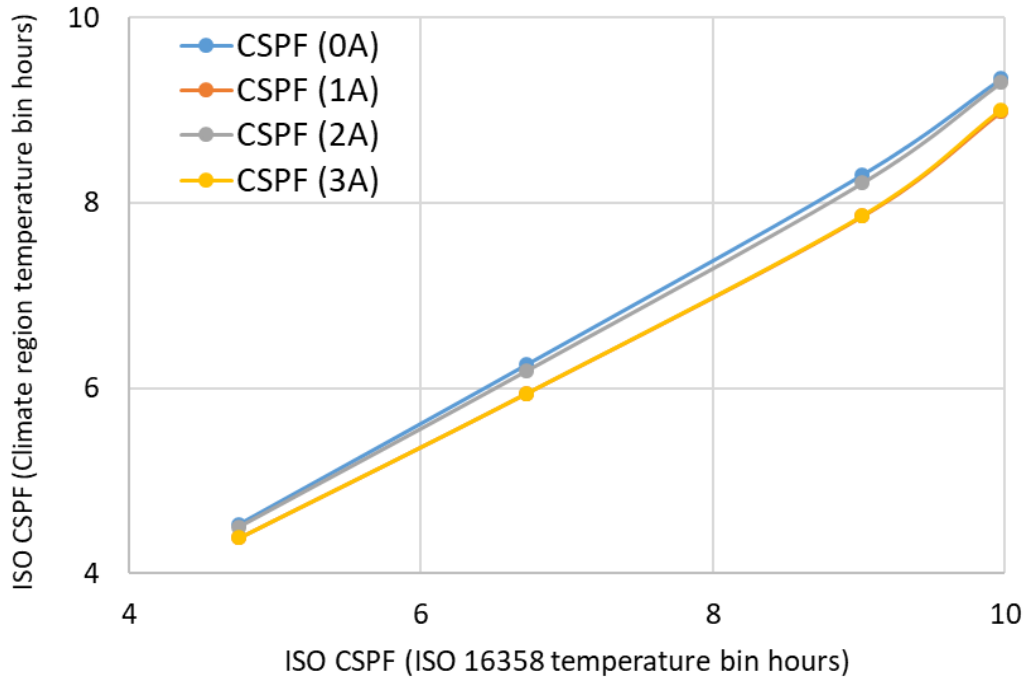
RAC– Energy Performance Grade Requirements

The high-efficiency levels represent approximately 30-60 percent of the efficiency improvement that is possible in energy-efficient technologies globally, but similar to or less than the efficiency levels of best available technologies.

Climate Group (Temperature Bin Hours)	Grade	Rated Cooling Capacity ≤ 4.5 kW	4.5 kW < Rated Cooling Capacity ≤ 9.5 kW	9.5 kW < Rated Cooling Capacity ≤ 16.0 kW
Group 1 (ISO 16358-1: 2013)	High Efficiency	8.00 ≤ CSPF	7.60 ≤ CSPF	7.10 ≤ CSPF
	Intermediate	7.10 ≤ CSPF < 8.00	6.40 ≤ CSPF < 7.60	5.80 ≤ CSPF < 7.10
	Low Efficiency	6.10 ≤ CSPF < 7.10	5.10 ≤ CSPF < 6.40	4.50 ≤ CSPF < 5.80
0A (Model Regulation)	High Efficiency	7.40 ≤ CSPF	7.00 ≤ CSPF	6.60 ≤ CSPF
	Intermediate	6.60 ≤ CSPF < 7.40	6.00 ≤ CSPF < 7.00	5.50 ≤ CSPF < 6.60
	Low Efficiency	5.70 ≤ CSPF < 6.60	4.90 ≤ CSPF < 6.00	4.30 ≤ CSPF < 5.50
1A (Model Regulation)	High Efficiency	7.00 ≤ CSPF	6.60 ≤ CSPF	6.20 ≤ CSPF
	Intermediate	6.20 ≤ CSPF < 7.00	5.70 ≤ CSPF < 6.60	5.20 ≤ CSPF < 6.20
	Low Efficiency	5.40 ≤ CSPF < 6.20	4.70 ≤ CSPF < 5.70	4.20 ≤ CSPF < 5.20
2A (Model Regulation)	High Efficiency	7.30 ≤ CSPF	6.90 ≤ CSPF	6.50 ≤ CSPF
	Intermediate	6.50 ≤ CSPF < 7.30	5.90 ≤ CSPF < 6.90	5.40 ≤ CSPF < 6.50
	Low Efficiency	5.60 ≤ CSPF < 6.50	4.80 ≤ CSPF < 5.90	4.30 ≤ CSPF < 5.40
3A (Model Regulation)	High Efficiency	7.00 ≤ CSPF	6.60 ≤ CSPF	6.20 ≤ CSPF
	Intermediate	6.20 ≤ CSPF < 7.00	5.70 ≤ CSPF < 6.60	5.20 ≤ CSPF < 6.20
	Low Efficiency	5.40 ≤ CSPF < 6.20	4.70 ≤ CSPF < 4.70	4.20 ≤ CSPF < 5.20

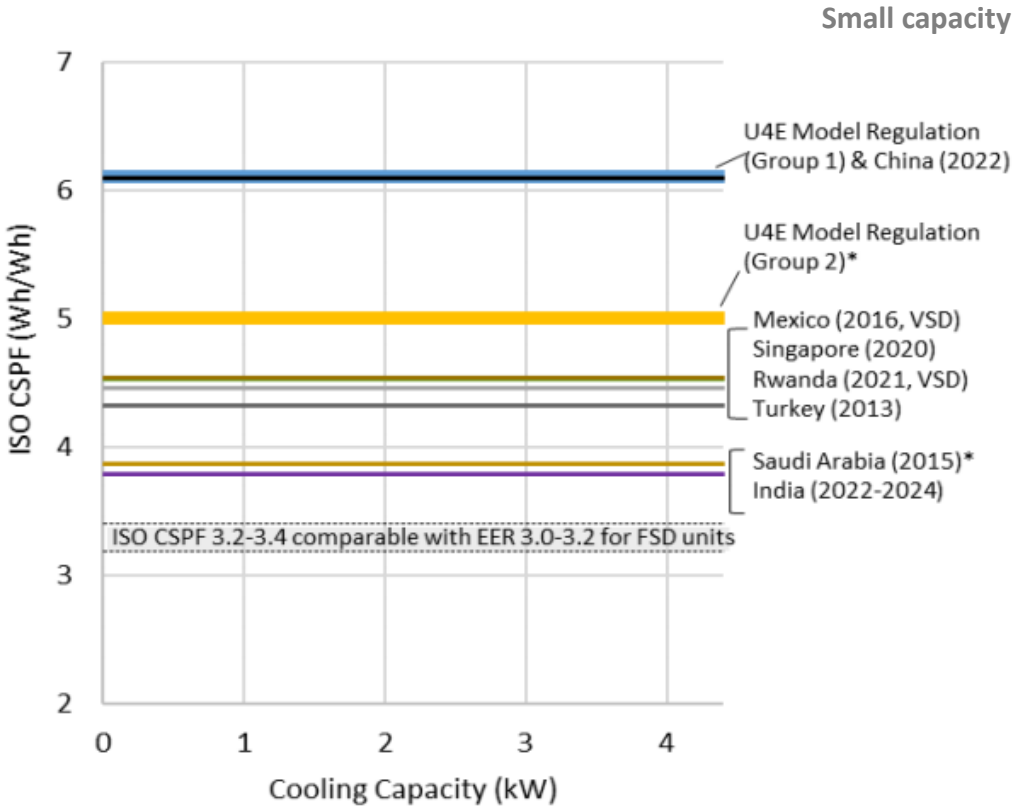
0A (extremely hot-humid); 1A (very hot-humid); 2A (hot-humid); 3A (warm-humid) by ASHRAE's climate zone definition.

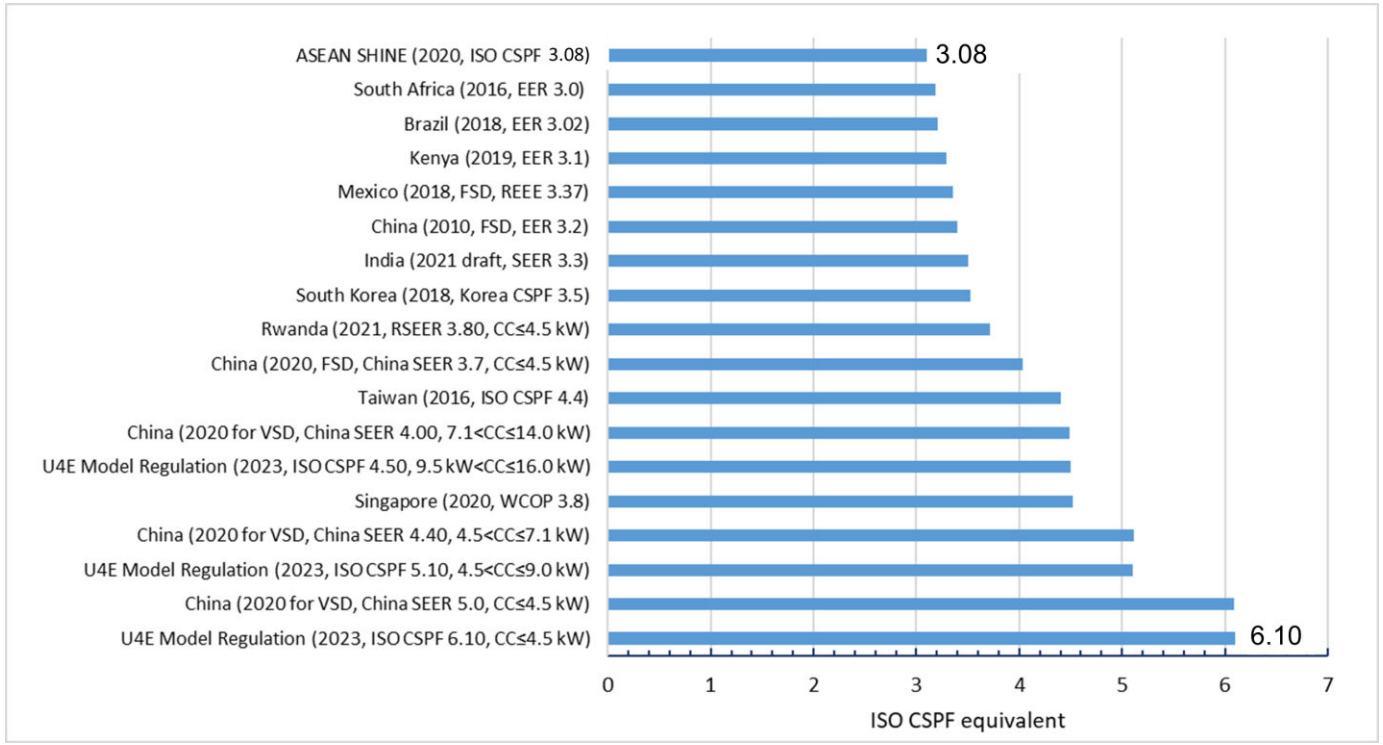
CSPF (ISO 16358 temperature bin hours) vs. CSPF (climate region temperature bin hours)



RAC– Minimum Energy Performance Requirements

The Model Regulation Guidelines suggest requirements to be consistent with the market transition expected from technology and policy improvements in major and emerging economies.





See the Model Regulation Guidelines Supporting Information for more details.

ISO CSPF for fixed-speed AC units results in a linear relationship with EER, i.e., CSPF = α × EER (e.g., α=1.062 with the ISO reference temperature bin hours), e.g., The CSPF for an EER 3.2 fixed-speed AC is ~3.40.

Inefficient products can't meet these levels, and there are stretch tiers for labels.

RAC– Refrigerant Requirements

Refrigerant GWP values refer to those specified in the IPCC's Fourth Assessment Report on which the GWPs of HCFCs and HFCs listed in Annex C and Annex F of the Montreal Protocol are based. The GWP values of refrigerants not included in the IPCC fourth assessment can be based on the latest IPCC assessment report.

Category	GWP	ODP
Self-Contained & Portable	150	0
Ductless Split	750	0

All units shall comply with standard ISO 5149 or IEC 60335-2-40:2018, a subsequent revision, or a nationally-modified edition of ISO 5149 or IEC 60335-2-40.

ISO 5149: Refrigerating Systems And Heat Pumps - Safety And Environmental Requirements

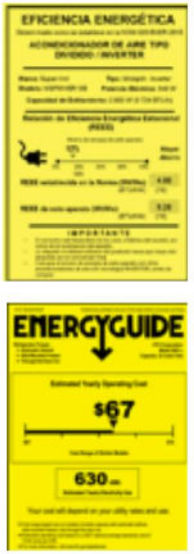
IEC 60335-2-40: Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

RAC– Label Information of the Product

All representations of energy performance shall indicate that the performance rating is based on the measurement according to [test standard name], an indicative value, and not representative of actual annual energy consumption in all situations.

Air Conditioners
1) Model name / serial number 2) Type of unit [ductless split, self-contained, or portable] 3) Country where the product was manufactured 4) Rated cooling (and heating, if applicable) capacity in kW 5) Rated maximum power consumption in kW 6) Rated performance grade 7) Rated energy efficiency in [CSPF, APF, EER, or COP], and yearly electricity consumption in kWh 8) Refrigerant designation in accordance with [ISO 817 or ASHRAE 34], including ODP and GWP.

ENDORSEMENT LABELS	COMPARATIVE – CATEGORIES	COMPARATIVE – CONTINUOUS	INFORMATIONAL
For products that meet or exceed a specified set of criteria; recognises premium models in the market; including most efficient, or climate-friendly refrigerants	Facilitate comparison between products on energy or other performance aspect in a discrete set of categories	Similar to comparative – categorical, but replaces the A to G or Star rating with a continuous sliding scale	Provides data on product performance or attributes (e.g. capacity, sound) but doesn't attempt to scale or rank
Voluntary	Mandatory	Mandatory	Mandatory or Voluntary
Eco-Logo; Germany Blue Angel	Ghana Star Label European A to G;	Mexican Energuide US EnerGuide	QR code



RAC– Compliance

- Government is responsible for checking compliance and surveilling the market.
- Manufacturers barred from selling non-compliant models; enforcement actions if not rectified*
- Manufacturers / importers submit Conformity Assessment Reports (CARs) for review prior to making the product available for sale.
- CARs are valid for 24 months. Updated CARs must be submitted 90 days prior to expiration.
- Regulations enter into force within 1-2 years of beginning the adoption procedure.
- Requirements should be strengthened after 5 years, based on updated market assessment.

* More details may be found in the 2017 U4E Policy Guides (here for refrigerators and here for air conditioners) and forthcoming additional guidance by U4E

Contact

TRANSFORMING MARKETS TO ENERGY-EFFICIENT PRODUCTS

PHONE

+33 1 44 37 19 86

EMAIL

unep-u4e@un.org

WEBSITE

united4efficiency.org