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Efficient Appliances for People & the Planet

How to Achieve the World's Best MEPS

Matt Malinowski and Shirin Mavandad

February 8 and 15, 2023

Agenda

Introduction

Presentation of report and recommendations

Moderated expert panel

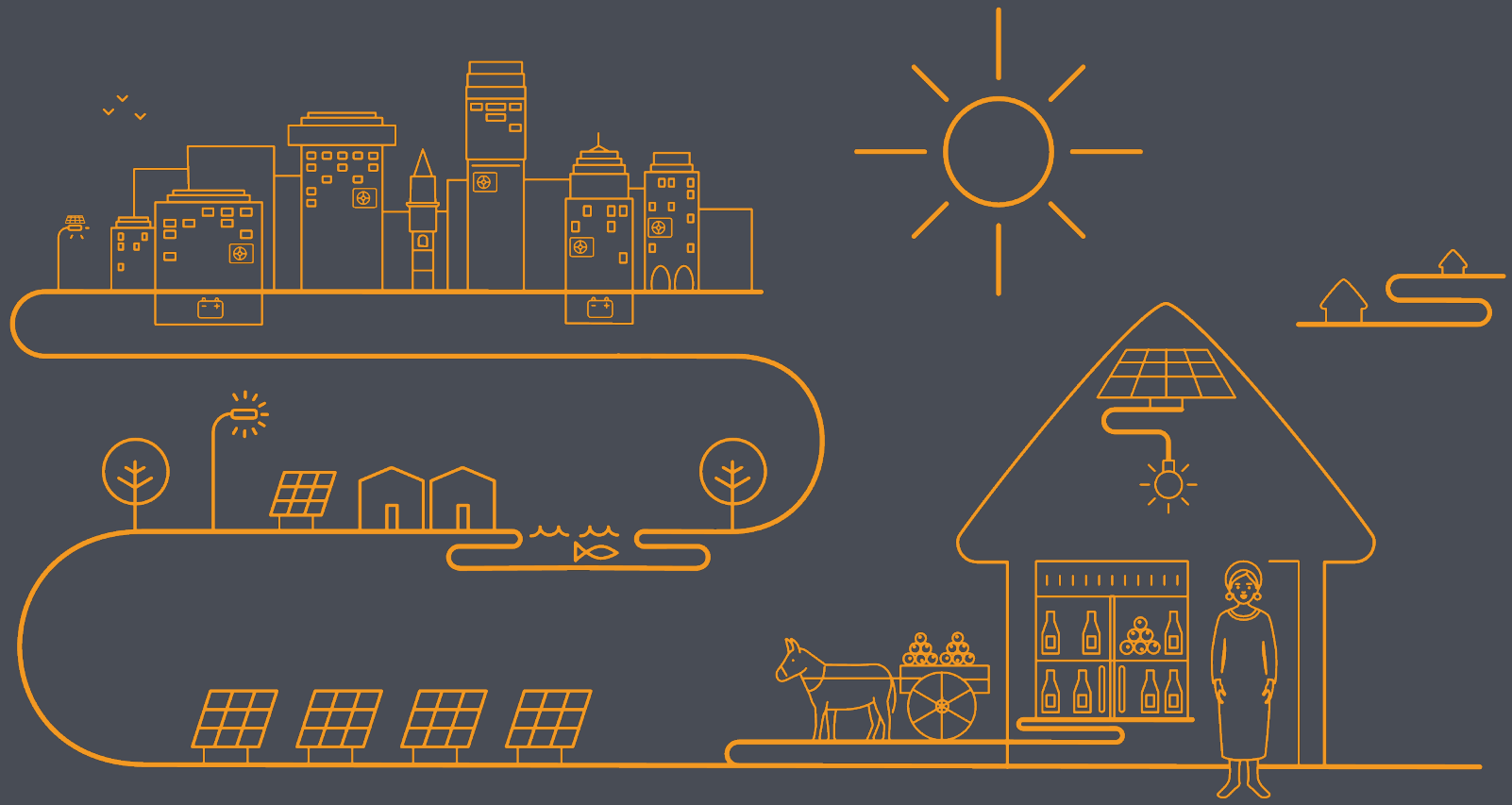
Audience Q&A

MISSION

CLASP improves the energy and environmental performance of the appliances & equipment we use every day, accelerating our transition to a more sustainable world.

clasp

Affordable, low-impact, high-quality appliances, lighting & equipment



- Reduce carbon emissions
- Lower operating costs
- Decrease energy demand
- Reduce energy supply cost
- Increase energy access
- Improve quality of life

Global Progress on Efficiency Relative to Benchmarks

New report and interactive web page

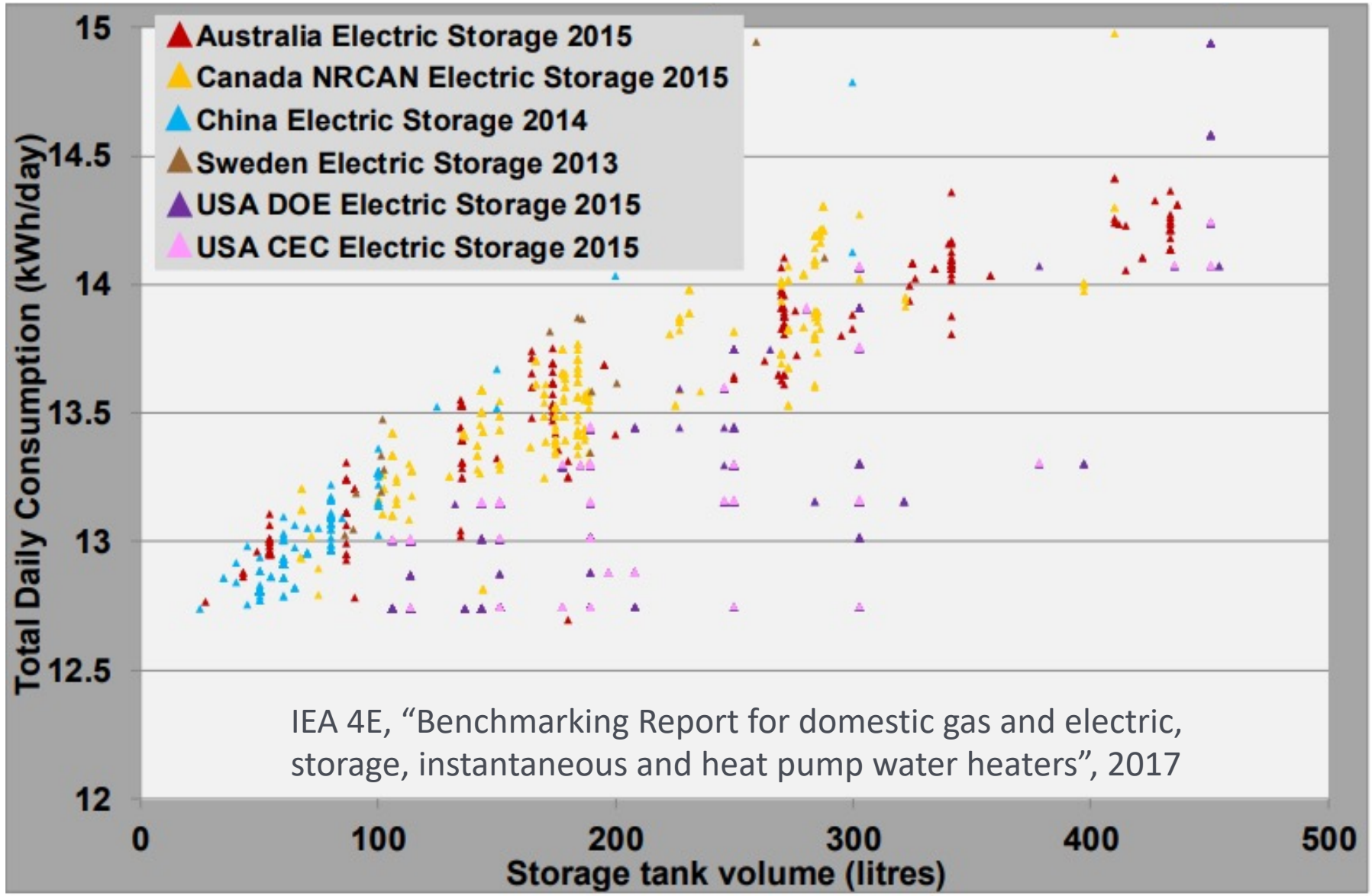
- https://www.clasp.ngo/tools/worlds-best-meps/
- Or scan here:

Scope of Analysis

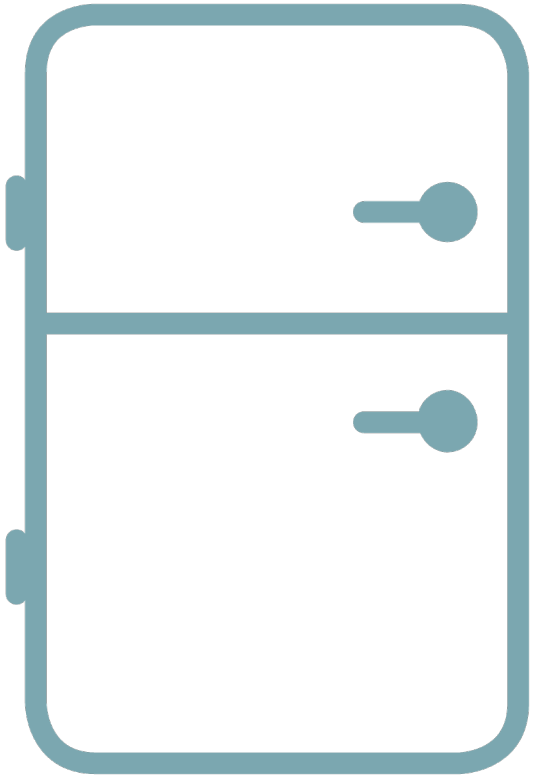
- What efficiency levels have been achieved today
  - Brazil
  - Canada
  - China
  - European Union
  - India
  - Indonesia
  - Japan
  - South Africa
  - United Kingdom
  - United States
- Global goals and benchmarks
  - United for Efficiency (U4E Model Regulations)
  - COP26 Call to Action on Doubling Appliance Efficiency
  - Electrification
  - Net-zero Energy
- Learn and drive ambition around the world

Conducting a Fair Comparison

- Not all economies can reach the same levels
  - Climate
  - Product availability
  - Economics
- Also, sometimes products are not completely comparable



Refrigerators



Product

400 L frost-free refrigerator-freezer

- 300 L fresh-food compartment
- 100 L top-mounted freezer compartment (3 star/-18 °C)

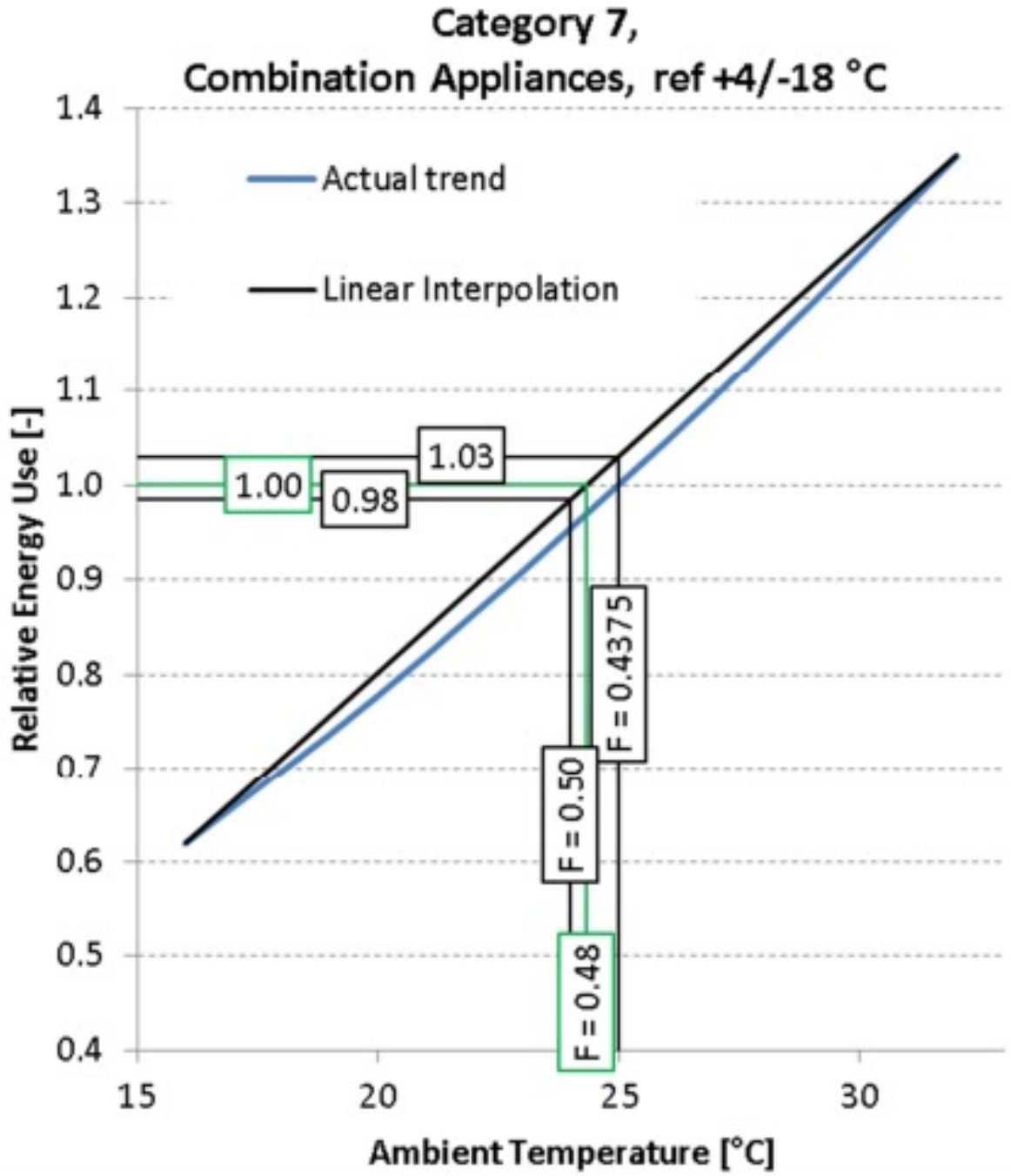
Metric

Annual energy consumption (kWh)

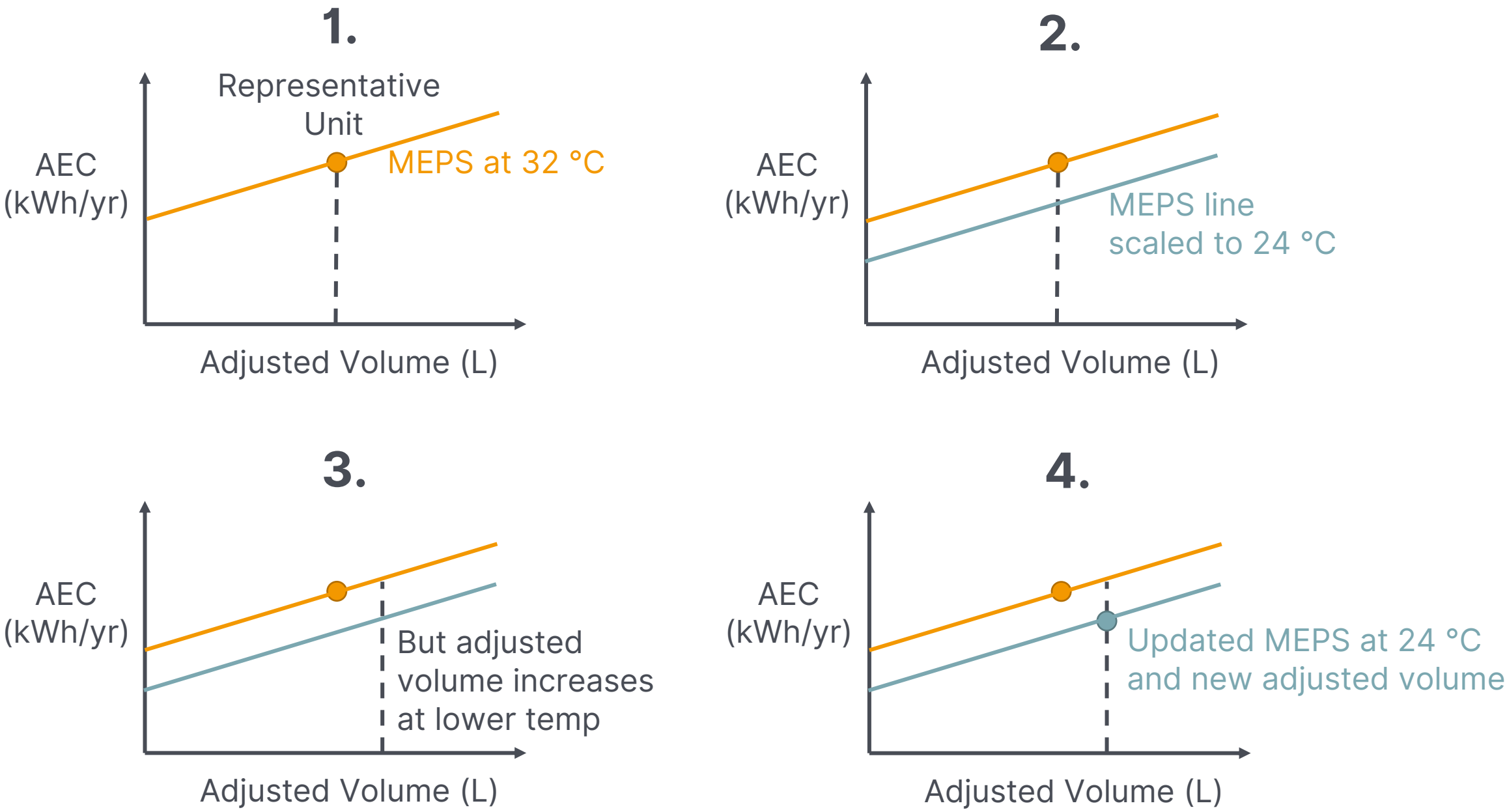
Refrigerators

MEPS evaluated at 32 °C were normalized to 24 °C

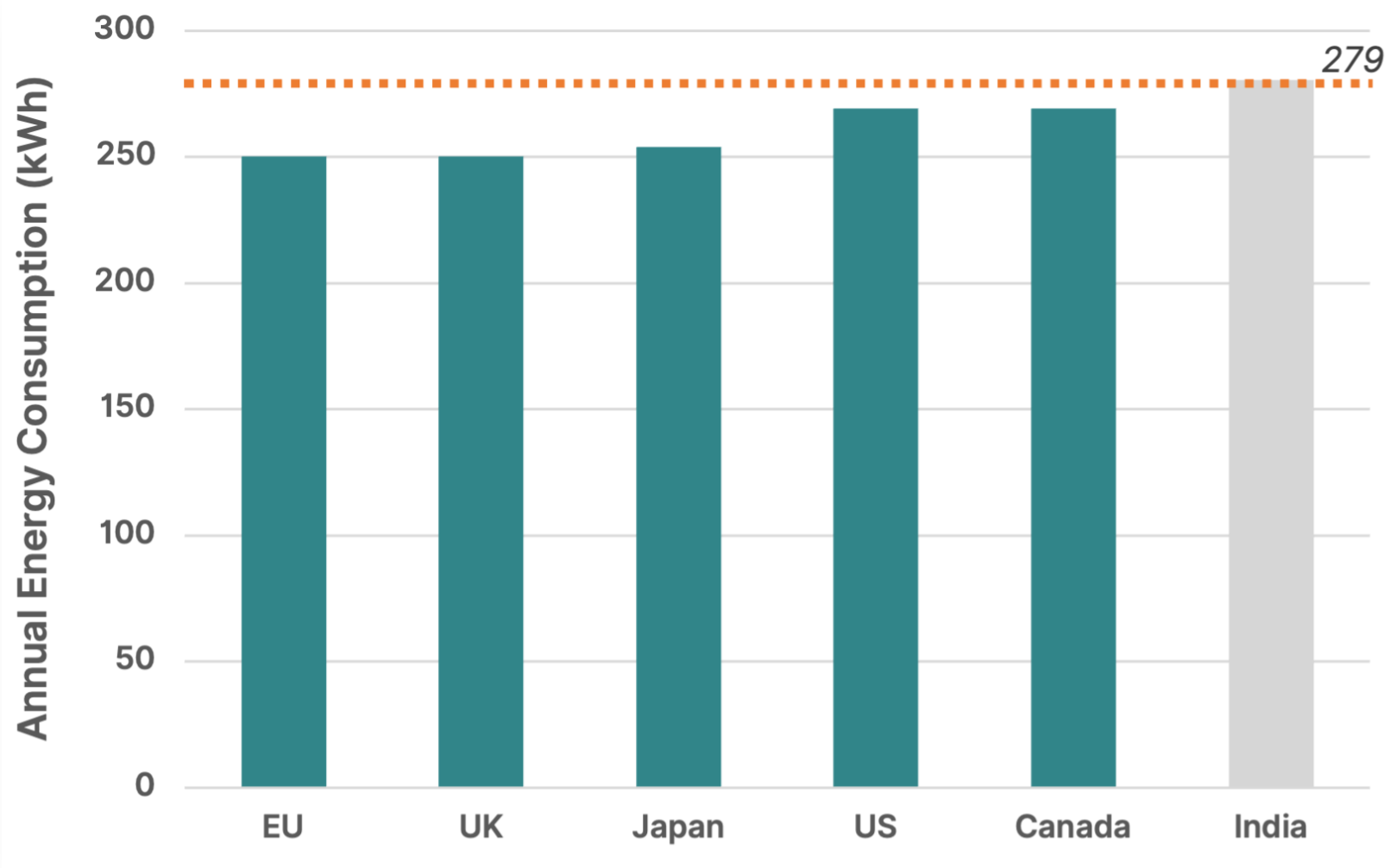
- Lower heat load
- Higher COP



Martien Janssen, "Impact of the new IEC 62552-1,2,3:2015 global standard to cold appliance energy consumption rating", Report number 14127CE40/V2, 29 May 2015, Appendix A https://ecodesign-fridges.eu/sites/ecodesign-fridges.eu/files/CECED%20Report_15127_CE40_V2_ImpactGlobalStandard.pdf


1.
Representative Unit
AEC (kWh/yr)
MEPS at 32 °C
Adjusted Volume (L)
2.
AEC (kWh/yr)
MEPS line scaled to 24 °C
Adjusted Volume (L)
3.
AEC (kWh/yr)
But adjusted volume increases at lower temp
Adjusted Volume (L)
4.
AEC (kWh/yr)
Updated MEPS at 24 °C and new adjusted volume
Adjusted Volume (L)

Refrigerators

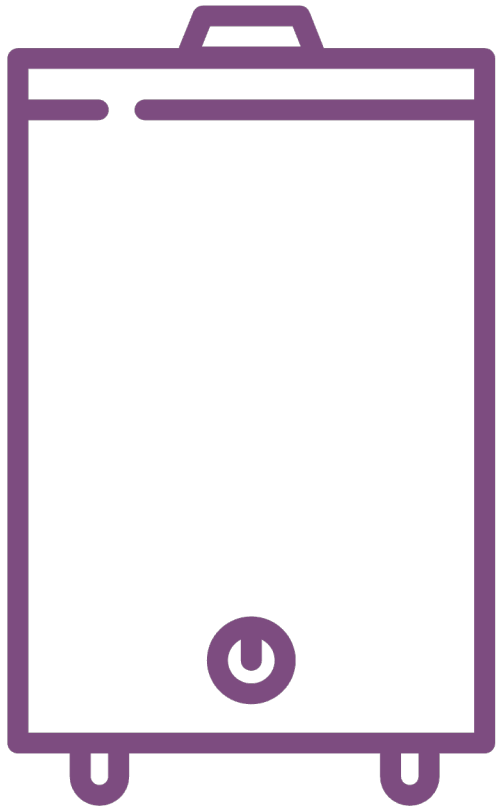


Refrigerators

Recommendations

- At a minimum, all economies should aim for MEPS at 279 kWh/year.
- Next, match U4E's intermediate target of 223 kWh/year.

Residential Water Heating



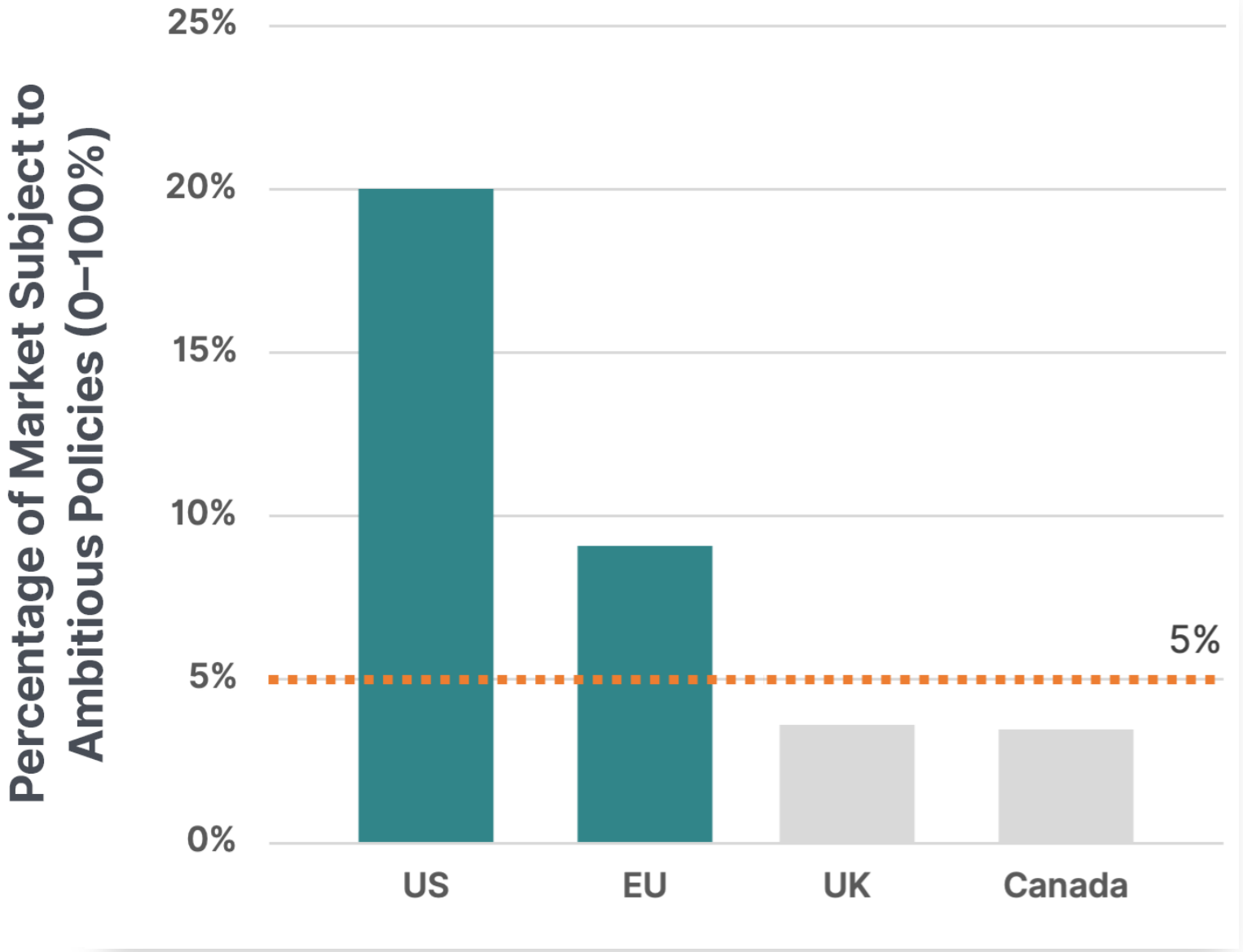
Product
Gas storage & instantaneous
Electric storage

Did not evaluate solar water heating

- China: 7–65% stock share
- India: 13% market share
- South Africa: 6% stock share

Focused on major technology shifts: condensing (≥86%) and heat pumps (>100%)

Residential Water Heating

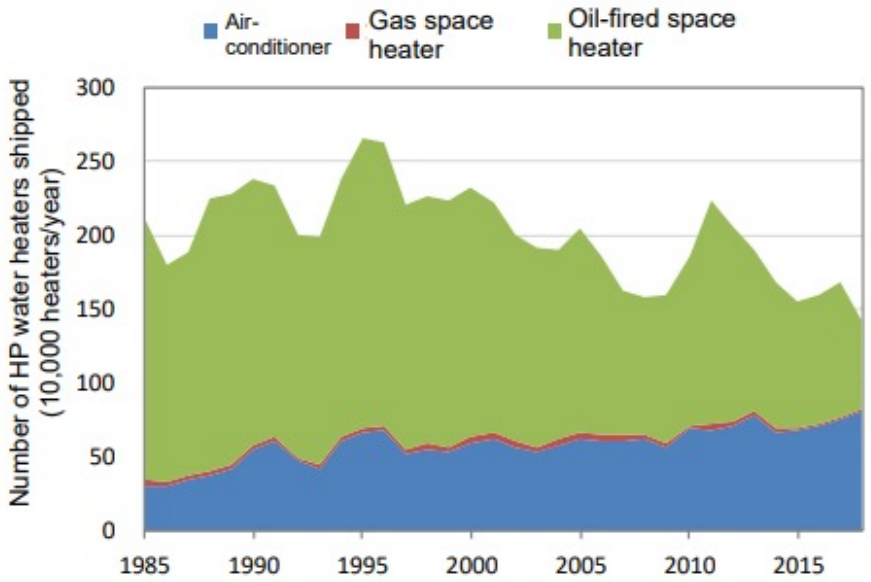


Residential Space Heating

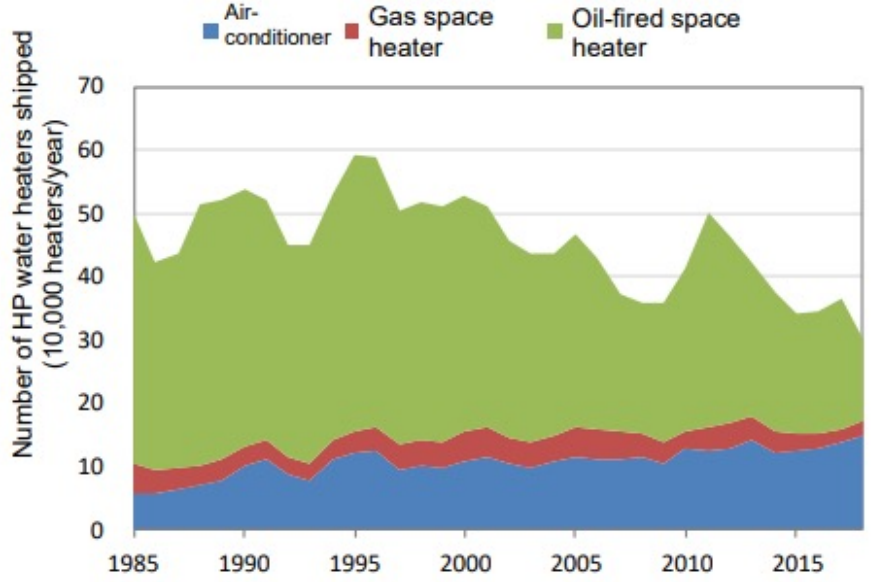
Product

Product types with significant potential for efficiency/CO_2 reduction:

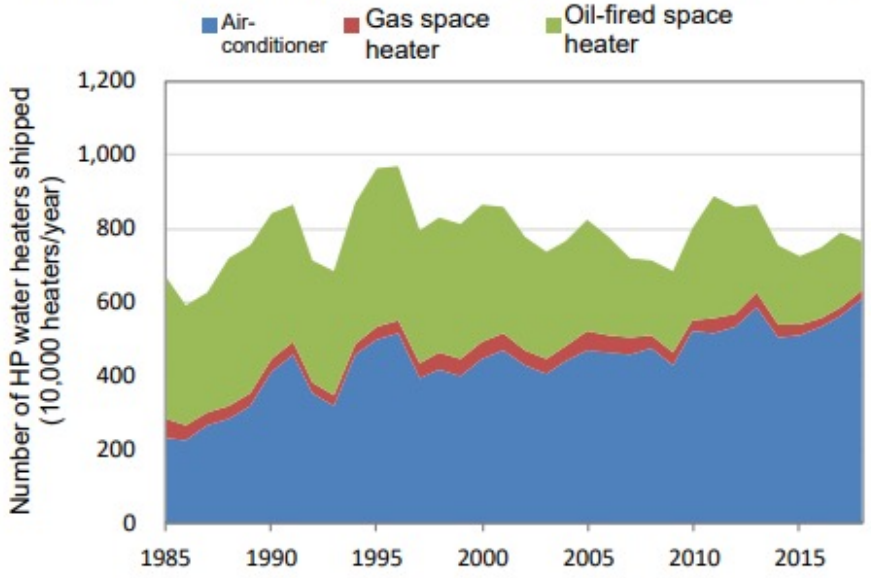
- Gas furnaces & boilers
- Electric resistance
- One-way air conditioners



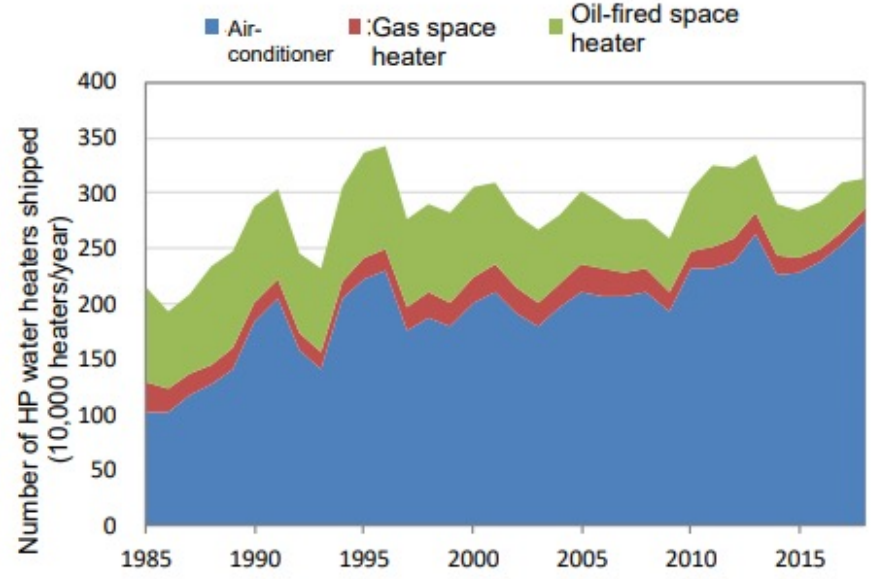
Market segment (1): Cold region, detached house



Market segment (2): Cold region, apartment house

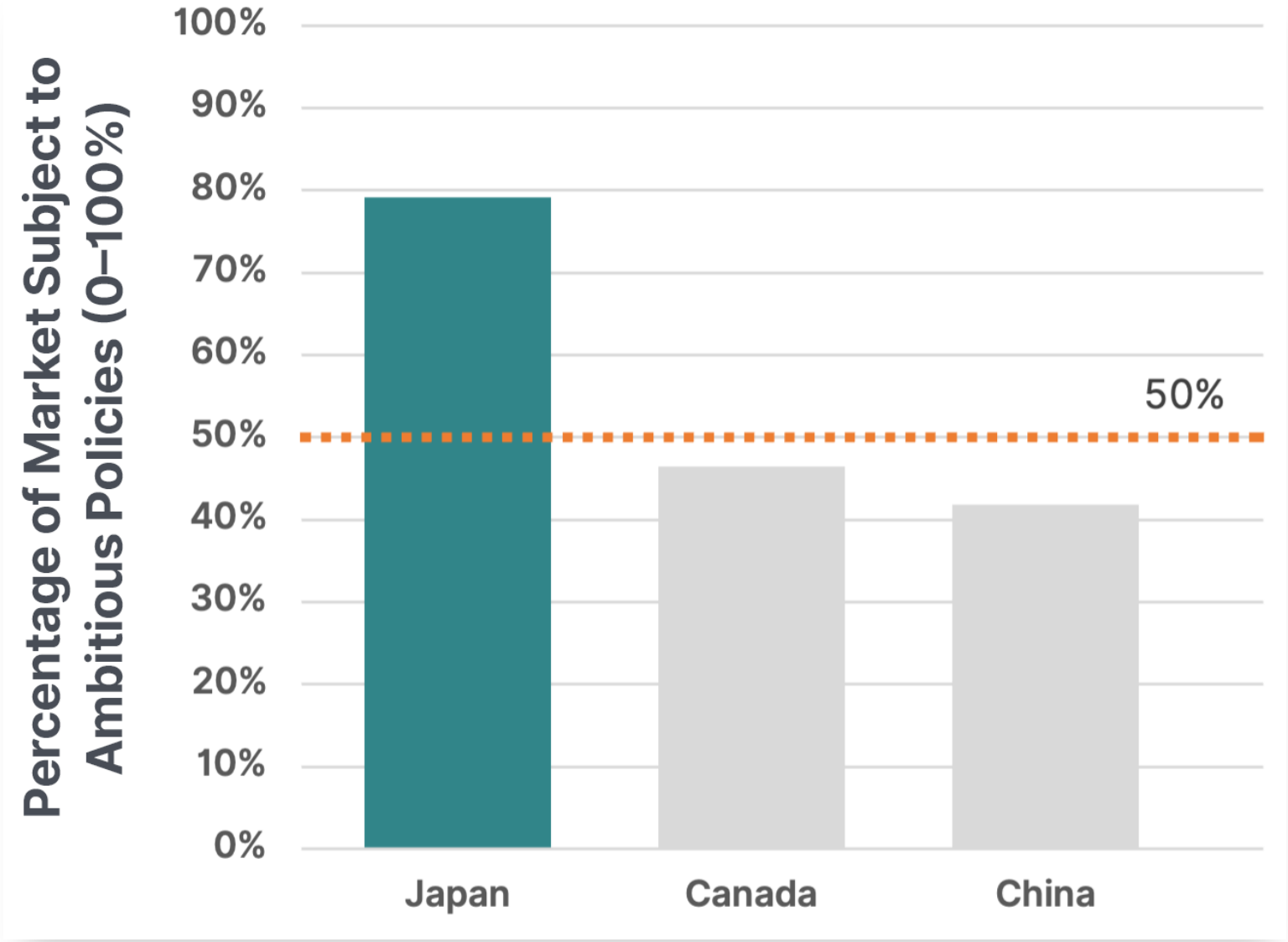


Market segment (3): Warm region, detached house



Market segment (4): Warm region, apartment house

Residential Space Heating



Residential Space Heating

Recommendation

- Require condensing efficiencies and heat pumps
- Replace one-way air conditioners with heat pumps

Energy and Mines Ministers' Conference. *Paving the Road to 2030 and Beyond: Market transformation road maps for energy efficient equipment in the building sector, 2018.*

Figure 5. Aspirational goals to 2035 for space heating in Canada

Short term: By 2025,

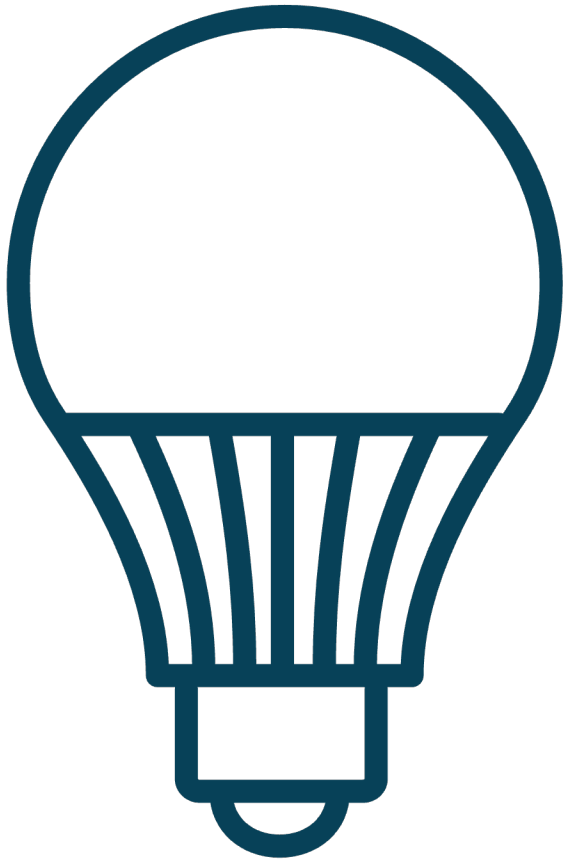
- All fuel-burning technologies for primary space heating for sale in Canada meet an energy performance of at least 90% (condensing technology).
- All air-source heat pumps for sale in Canada meet a SCOP greater than 2.5,[10] at least 30% better performance than today.

Medium term: By 2030,

- A residential natural gas heat pump with a SCOP greater than 1.2 can be manufactured and installed cost-effectively.[11]
- A residential cold climate air-source heat pump with a SCOP greater than 2.75 can be manufactured and installed cost-effectively.[12]
- The deployment of heating systems using renewable technologies and renewable resources is supported.

Long term: By 2035, all space heating technologies for sale in Canada meet an energy performance of more than 100%.

Residential Lighting



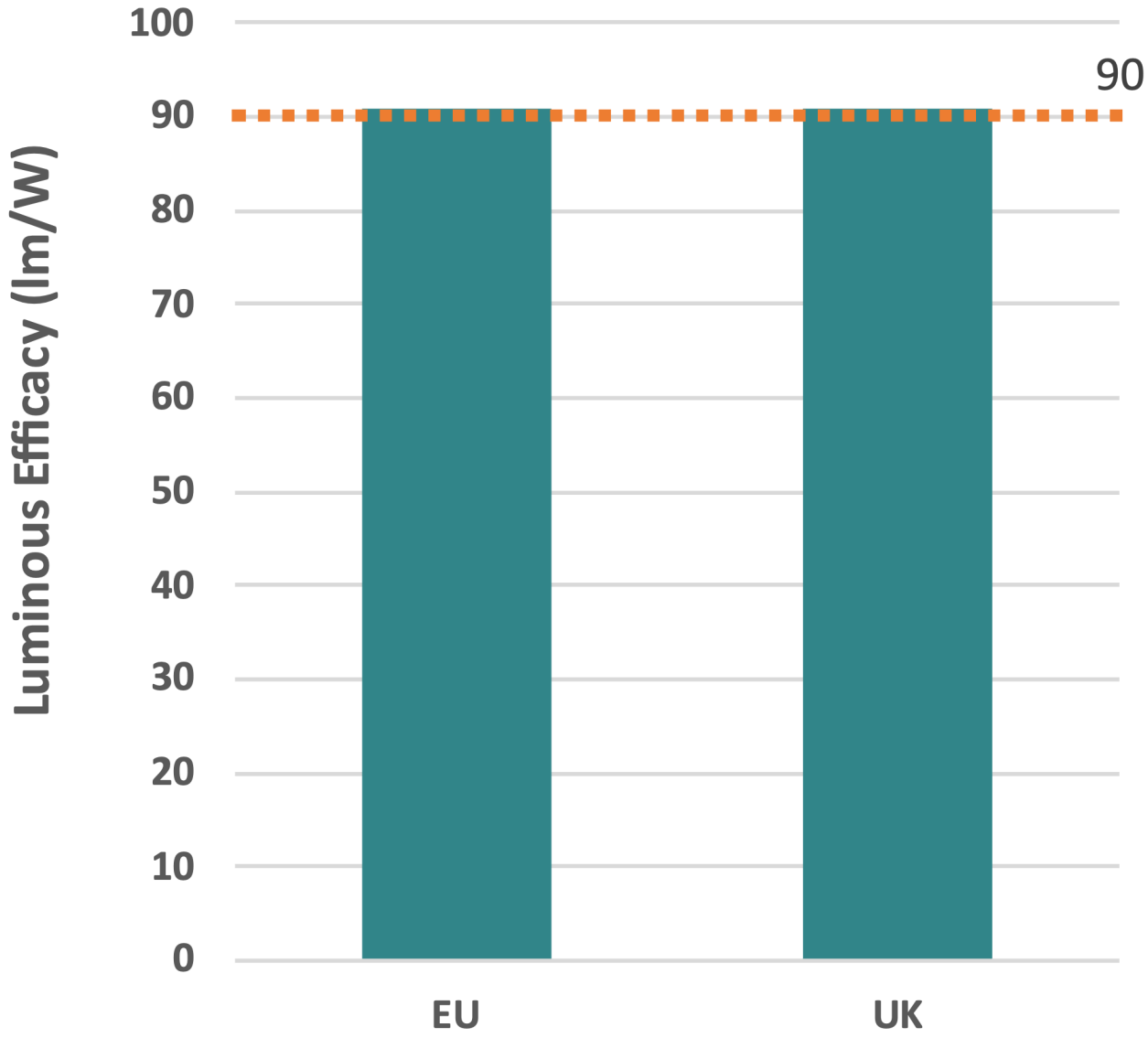
Product
Indoor, non-directional general service lamps

Metric
Minimum luminous efficacy (lm/W)

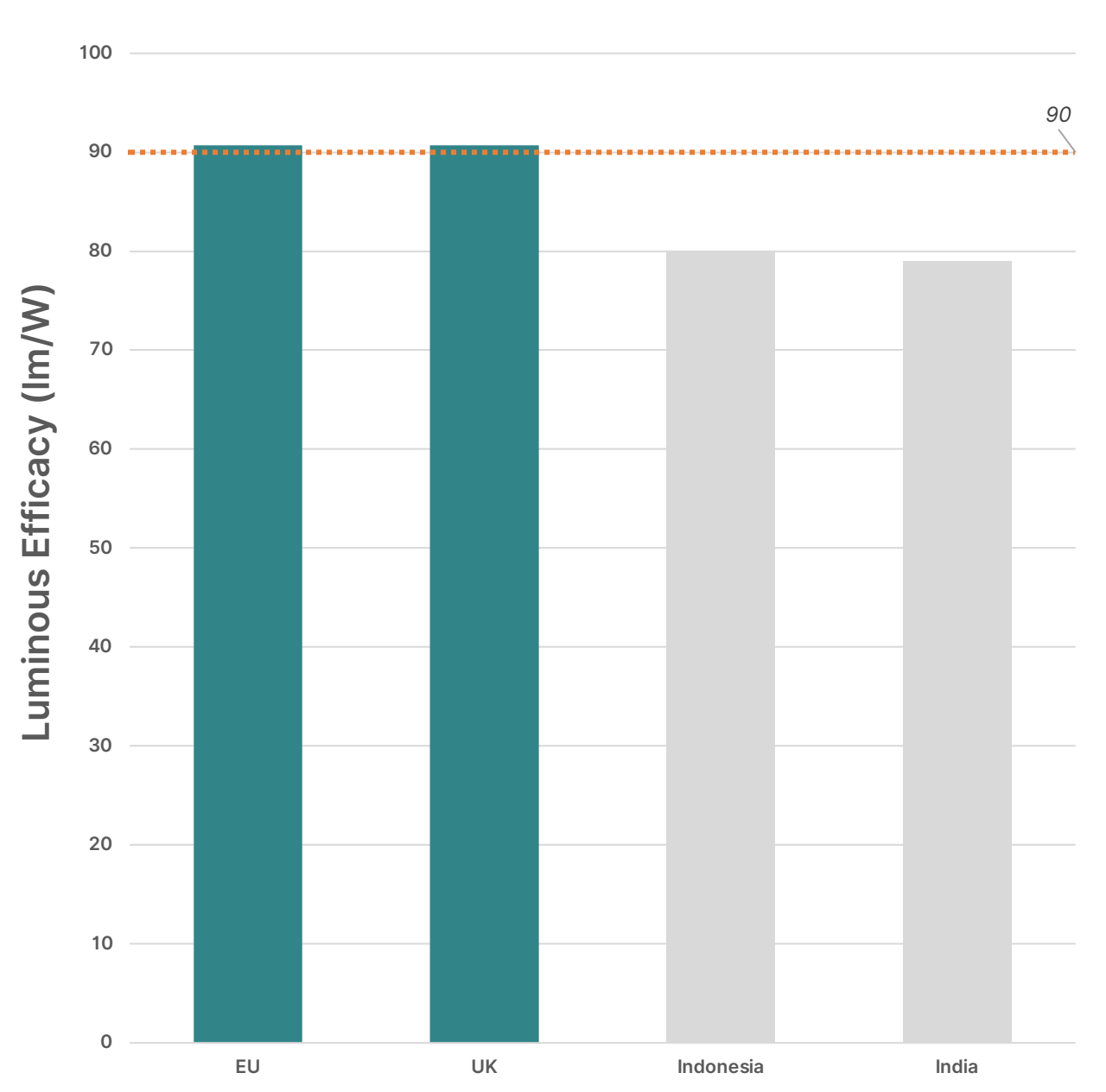
	Column 1	Column 2	Column 3
Item	Energy-using Product	Energy Efficiency Standard	Period of Manufacture
1	General service lamps that have a luminous flux of < 750 lm	Nominal power ≤ 29 W Life ≥ 1 000 hours Colour rendering index ≥ 80	On or after December 31, 2014
2	General service lamps that have a luminous flux of ≥ 750 lm and < 1 050 lm	Nominal power ≤ 43 W Life ≥ 1 000 hours Colour rendering index ≥ 80	On or after December 31, 2014
3	General service lamps that have a luminous flux of ≥ 1 050 lm and < 1 490 lm	Nominal power ≤ 53 W Life ≥ 1 000 hours Colour rendering index ≥ 80	On or after January 1, 2014
4	General service lamps that have a luminous flux of ≥ 1 490 lm	Nominal power ≤ 72 W Life ≥ 1 000 hours Colour rendering index ≥ 80	On or after January 1, 2014

Government of Canada, “Energy Efficiency Regulations, 2016 (SOR/2016-311),” 2016, https://laws-lois.justice.gc.ca/eng/regulations/SOR-2016-311/page-22.html#docCont.

Residential Lighting



Residential Lighting

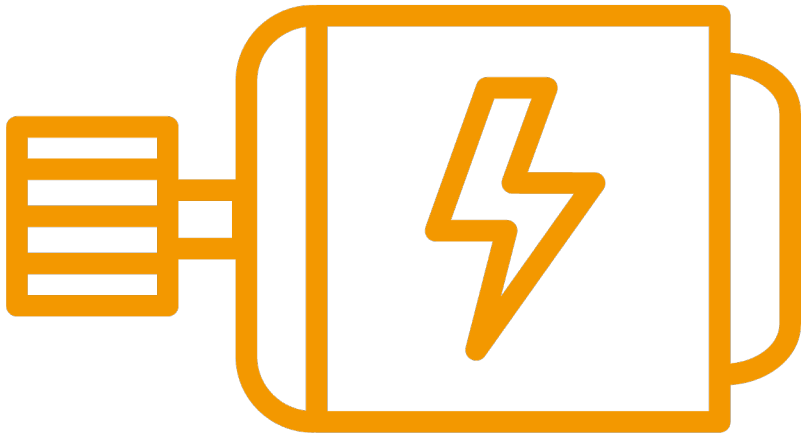


Residential Lighting

Recommendations

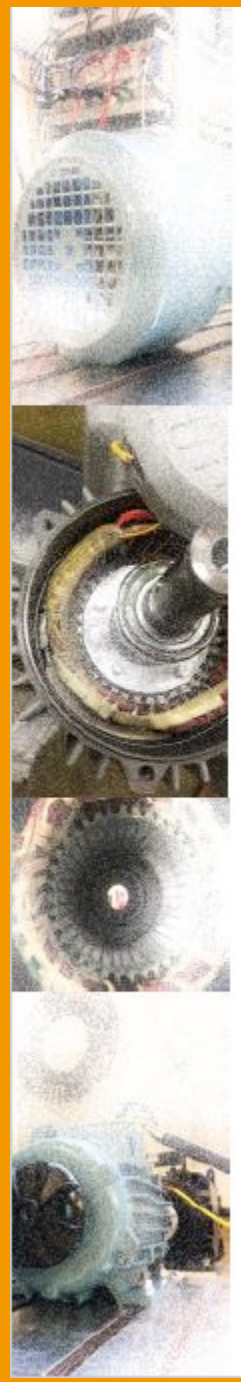
- All economies should adopt **technology-neutral MEPS** at 90 lm/W or greater.
- Economies already meeting this requirement should strive for more stringent MEPS of at least 120 lm/W.

Electric Motors

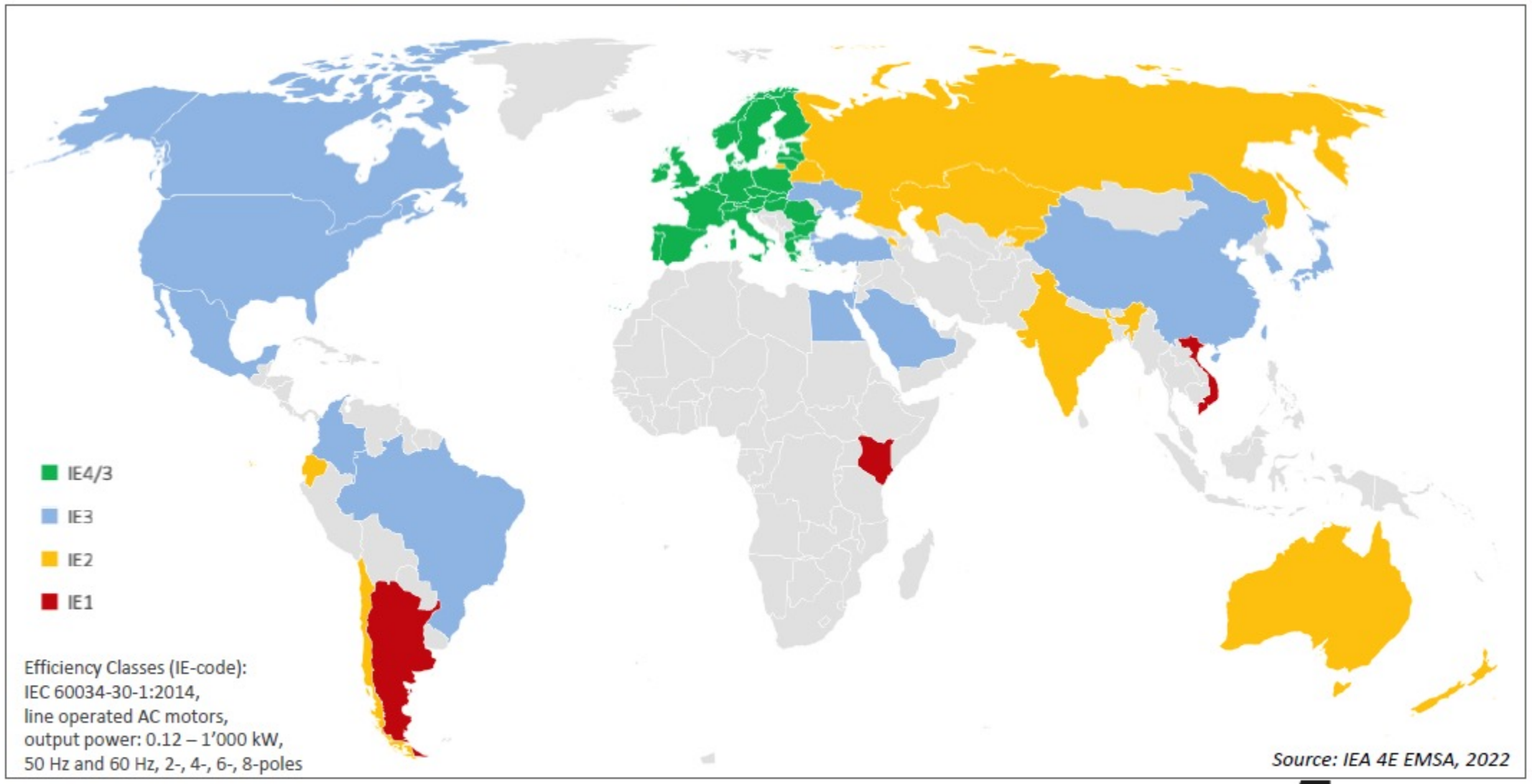


Product
3-phase Induction Motor <1000 V

Metric
Efficiency class under IEC 60034-30-1 & additional MEPS for motor driven applications



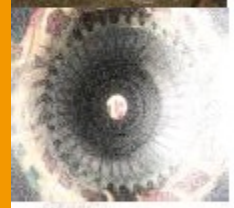
Minimum Energy Performance Requirements Electric Motors



EU: **Tier1** per 15/7/2021: IE3 (0.75-1'000 kW), IE2 (0.12-0.75 kW), **Tier2** per 1/7/2023: same as Tier 1 + IE4 (75-200 kW). Note: UK and CH have applied EU regulation in full.

4E Electric Motor Systems EMSA






IEC and ISO Standards and MEPS motors, converters, pumps, fans, compressors

Component	Scope	Testing Standard	Efficiency Classification Standard				Performance Requirement
				efficiency metric	P [I]	EP	Mandatory MEPS [II]
Motor	3-phase induction motors (Low Voltage < 1'000 V)	IEC 60034-2-1 IEC 60034-2-3	IEC 60034-30-1 IEC 60034-30-2	IE	x		30+ countries/regions, see
Converter	Variable Frequency Converter (VFC, VSD)	IEC 61800-9-2	IEC 61800-9-2	IE	x		EU
Pump	Rotodynamic water pump	ISO 9906	- EU: EN 16480 US: DOE x CN: GB-x	- MEI PEI EI	 x x	 x 	 EU USA China
Fans	Industrial	ISO 5801	ISO 12759-1 ISO 12759-2 ISO 12759-3 ISO 12759-4 ISO 12759-5 ISO 12759-6 (CD)	 standard losses FEG FMEG JFEMG FEI	 x 	 x x	 - China EU US
Air compressor	Compressor package	ISO 1217	ISO 1217 ISO 1217, Am.1:2016	Compressor efficiency grade Isentropic efficiency		x x	China USA

01 05 2022

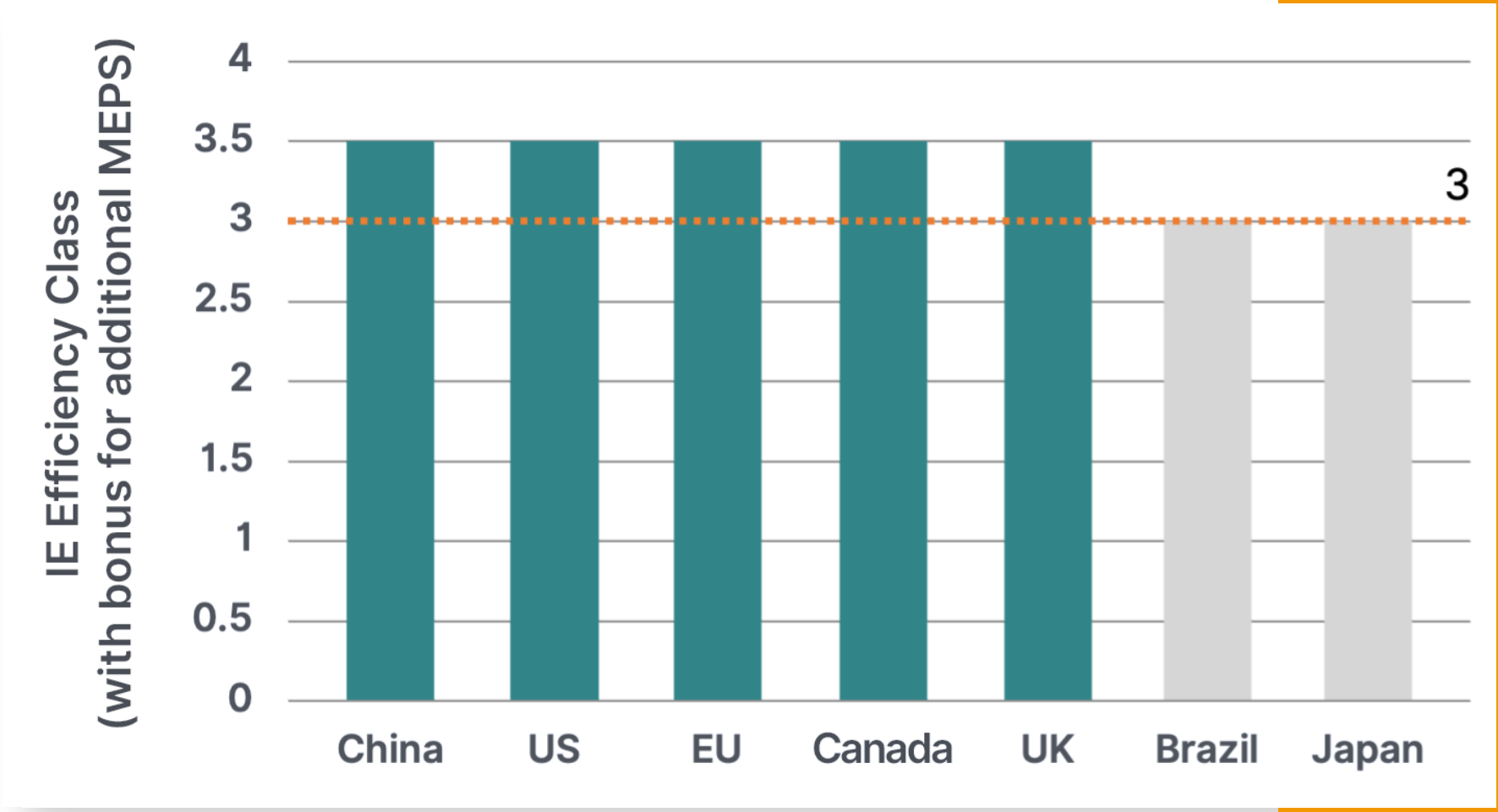
I P = product, EP = extended product (motor, control, transmission, pump/fan/compressor)

II MEPS = Minimum Energy Performance Standard (set as requirement by regulators)

Source: IEA 4E EMSA, 2022

4E Electric Motor Systems EMSA

Electric Motors



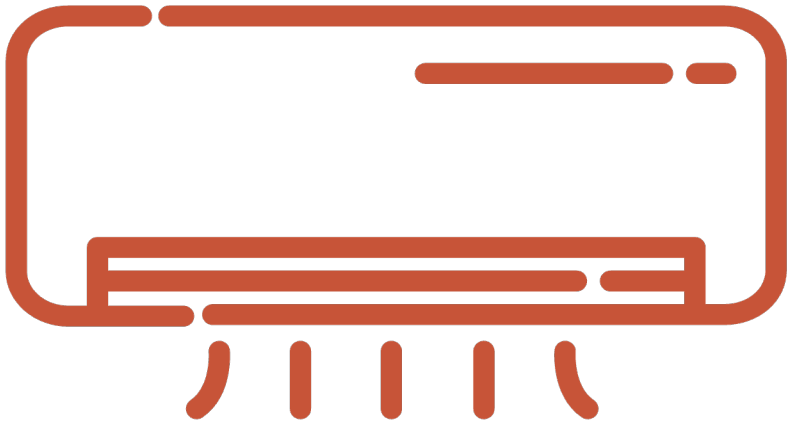
Electric Motors

Recommendations

- All economies should require a **minimum efficiency class of IE3**, while leading economies should strive for IE4 or IE5.

- Economies should also consider adopting requirements for additional components such as **variable speed drives** or for **industrial pumps, fans, and air compressors**.

Air Conditioners



Product
7 kW split-system unit

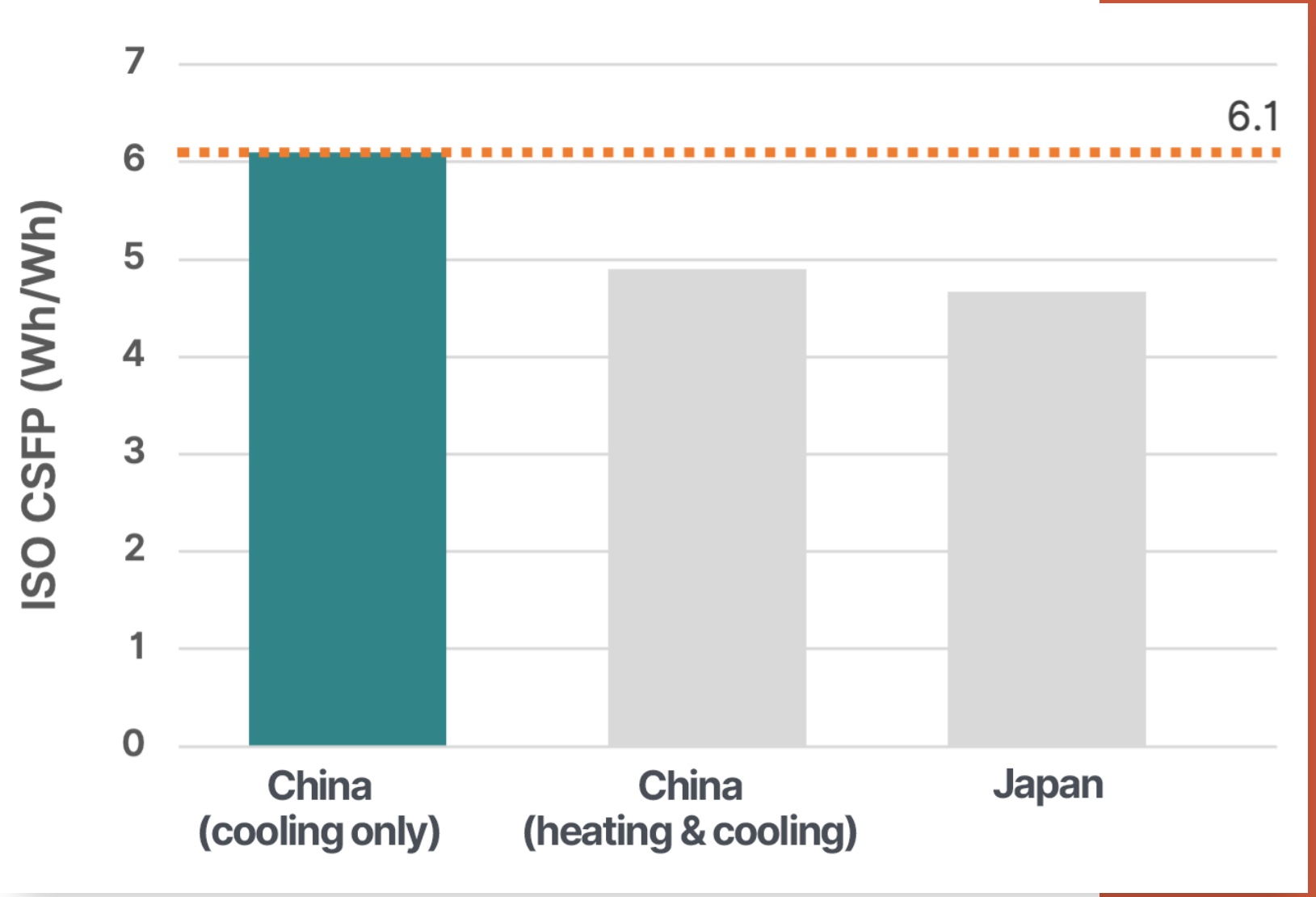
Metric
Seasonal energy efficiency metric (ISO CSPF Wh/Wh)

Table B1
Interregional conversion relationships of seasonal energy efficiency for split room ACs, based on the data of two FSD and four VSD models (Group A).

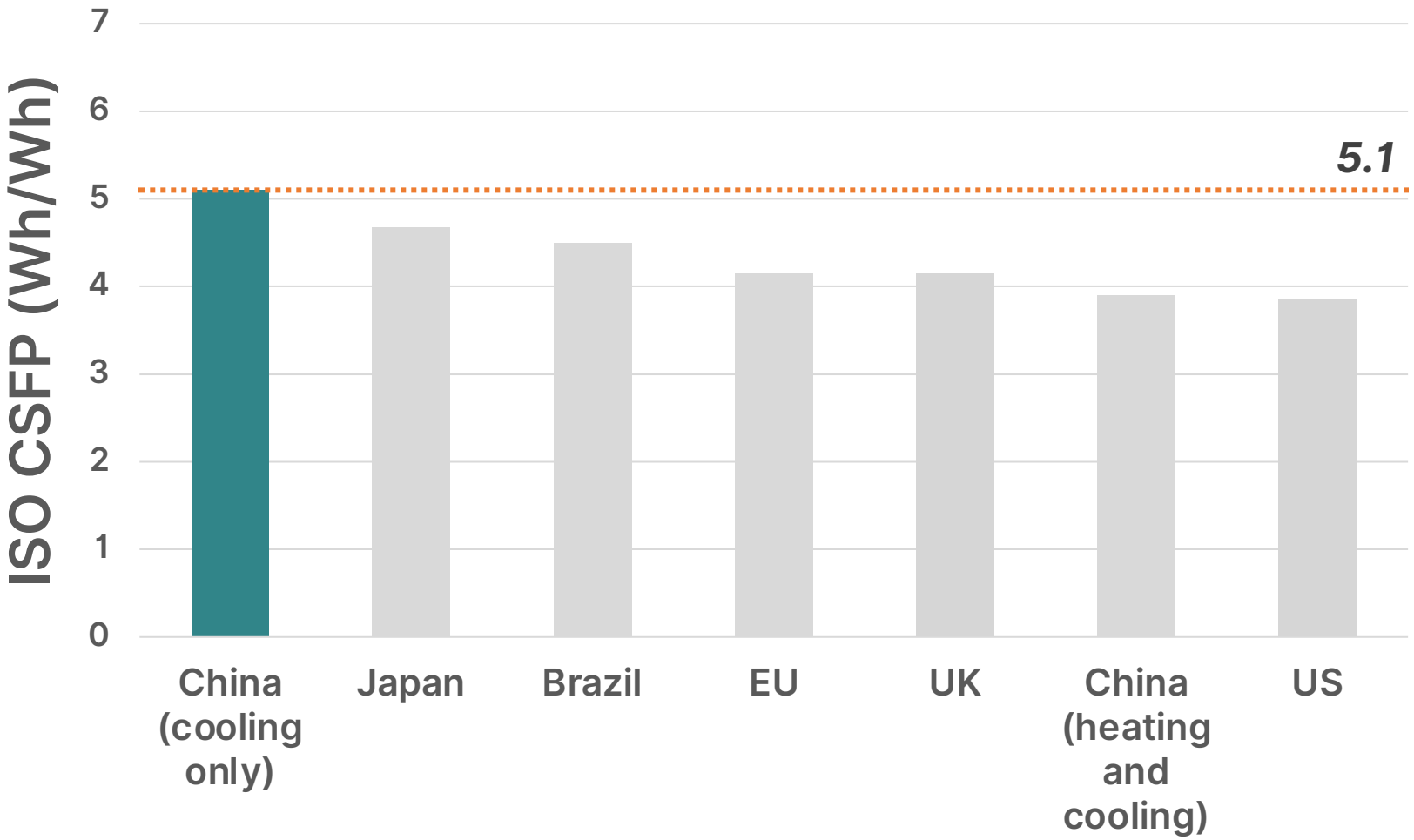
Y	X	$Y = d + \frac{a-d}{(1+(\frac{X}{c})^{b})}$							Alternative (linear, logarithm, or exponential)
		a	b	c	d	R^2	p-value	Std. error	
ISO CSPF	ISEER	1.847	3.269	5.473	12.156	0.999	0.002	0.134	7.726·ln(X)-5.318 ($R^2 = 0.996$)
	China APF	3.105	7.216	4.659	10.287	0.994	0.011	0.330	1.798·X-2.027 ($R^2 = 0.970$)
	Japan APF	3.348	5.036	7.349	14.855	1.000	0.001	0.087	1.735·exp. (0.220·X) ($R^2 = 0.976$)
	Korea CSPF	3.244	4.490	7.179	11.221	0.999	0.002	0.132	0.970·X + 0.048 ($R^2 = 0.991$)
	U.S. SEER	1.728	1.741	15.127	26.177	1.000	0.000	0.047	0.962·X + 0.087 ($R^2 = 0.999$)
	EU SEER	−0.600	1.006	521,765	617,390	1.000	0.001	0.079	1.113·X-0.639 ($R^2 = 0.999$)
ISEER	ISO CSPF	2.465	1.765	15,334	2,215,983	0.996	0.007	0.192	2.085·exp. (0.137·X) ($R^2 = 0.996$)
	China APF	2.804	4.813	5.305	9.716	0.996	0.008	0.207	1.323·X-0.883 ($R^2 = 0.986$)
	Japan APF	3.150	3.696	248	1,790,672	0.997	0.006	0.172	1.807·exp. (0.184·X)c ($R^2 = 0.956$)
	Korea CSPF	2.982	3.200	9.533	12.086	0.997	0.005	0.166	2.094·exp. (0.133·X) ($R^2 = 0.992$)
	U.S. SEER	2.574	1.826	11,731	2,126,699	0.998	0.005	0.159	2.108·exp. (0.132·X) ($R^2 = 0.997$)
	EU SEER	2.322	1.823	10,862	2,158,012	0.994	0.011	0.239	1.910·exp. (0.152·X) ($R^2 = 0.995$)
China APF	ISEER	−0.369	0.781	21,142,970	729,082	0.987	0.027	0.278	0.745·X + 0.723 ($R^2 = 0.986$)
	ISO CSPF	2.405	1.603	33,306	1,919,929	0.974	0.051	0.385	0.539·X + 1.232 ($R^2 = 0.970$)
	Japan APF	2.936	3.210	486	2,193,369	0.982	0.036	0.321	1.849·exp. (0.160·X) ($R^2 = 0.967$)
	Korea CSPF	2.215	1.455	50,896	1,076,342	0.980	0.040	0.338	0.527·X + 1.233 ($R^2 = 0.976$)
	U.S. SEER	2.525	1.695	21,683	1,818,168	0.975	0.049	0.377	0.519·X + 1.280 ($R^2 = 0.969$)
	EU SEER	2.198	1.598	29,631	1,717,656	0.973	0.053	0.391	0.600·X + 0.887 ($R^2 = 0.970$)
Japan APF	ISEER	−9,160,614	1.788	0.001	8.854	0.994	0.012	0.248	5.207·ln(X)-2.840 ($R^2 = 0.956$)
	China APF	1.763	5.614	3.953	8.002	0.987	0.027	0.370	6.061·ln(X)-3.546 ($R^2 = 0.967$)
	ISO CSPF	−6,822,450	0.975	2.59E-06	10.239	0.989	0.021	0.328	4.428·ln(X)-2.307 ($R^2 = 0.976$)
	Korea CSPF	−555,719	0.533	5.07E-09	13.961	0.990	0.019	0.315	4.399·ln(X)-2.352 ($R^2 = 0.985$)
	U.S. SEER	−4,881,884	0.788	1.63E-07	11.142	0.989	0.022	0.337	4.342·ln(X)-2.250 ($R^2 = 0.979$)
	EU SEER	−7,207,856	1.180	2.94E-05	9.904	0.992	0.017	0.290	4.923·ln(X)-3.205 ($R^2 = 0.975$)

Won Park, et al., "Lost in Translation: Overcoming Divergent Seasonal Performance metrics to Strengthen Air Conditioner Energy-Efficiency Policies," Energy for Sustainable Development, February 1, 2020, https://eta-publications.lbl.gov/sites/default/files/1-s2.0-s0973082619313560-main.pdf.

Air Conditioners



Air Conditioners



Air Conditioners

Recommendations

- At a minimum, all economies should adopt **technology-neutral MEPS of 5.1 Wh/Wh** or greater.
- Additionally, any economy using an energy efficiency ratio (EER) should **switch to a seasonal performance metric** for fixed and variable-speed ACs.

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Unlimited Resources Ltd.

Maarten van Werkhoven
TPA Adviseurs

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Efficient Appliances for People & the Planet

1. What potential challenges do you foresee in advancing MEPS in the countries you have expertise on / what are tools policymakers can use to overcome those challenges?

2. Is there any product category that you think a particular economy should prioritize when advancing their MEPS? Or enabling specific actions that will help improve the overall process?

Audience Q&A

Please submit questions through the Q&A feature or the chat box.

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Efficient Appliances for People & the Planet

clasp.ngo/tools

World's Best MEPS

Comparison of world-leading appliance efficiency standards

Mepsy

Model the impacts of energy and carbon reduction policies

CPRC

Searchable database of 1500+ quality, water, and efficiency policies

VeraSol

Solar-powered and off-grid appliance database

Compliance Toolkit

Resources to help design effective compliance strategies

Computer Testing Tool

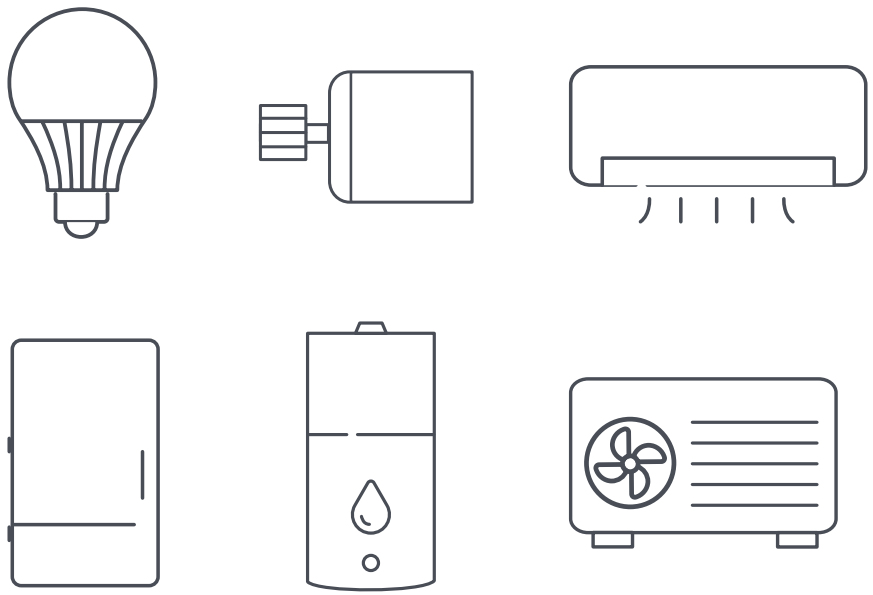
Measure the power and performance of a personal computer

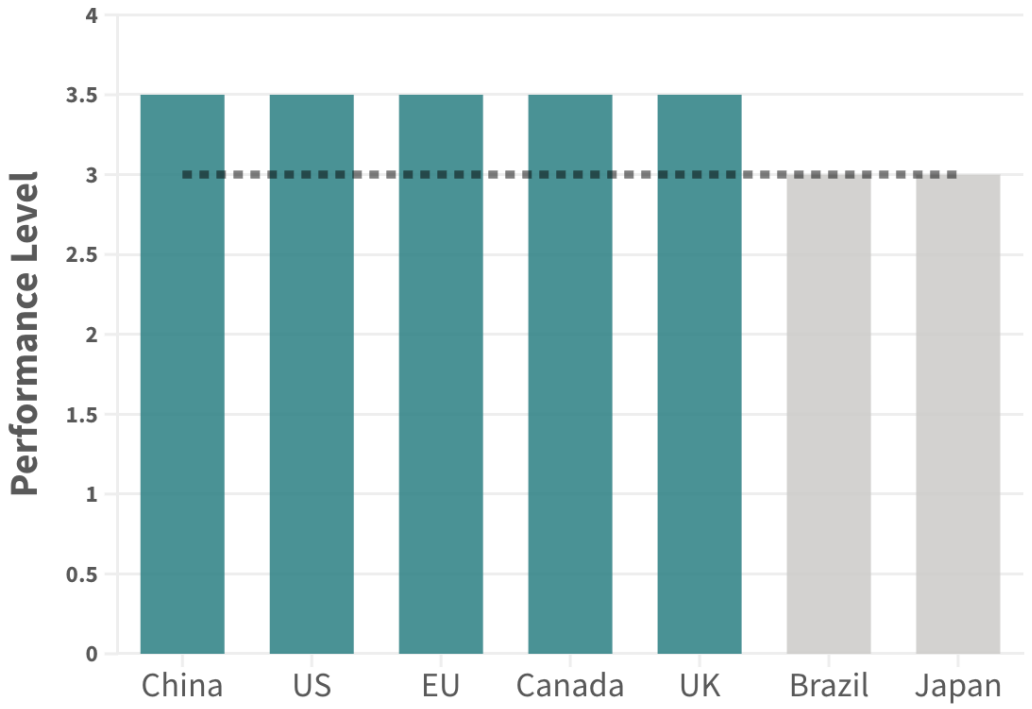
World's Best MEPS *clasp.ngo/tools/worlds-best-meps*

Comparison of world-leading efficiency standards

Ratings of MEPS for six key appliance & equipment types across ten major economies, updated as needed

- Brazil
- Canada
- China
- European Union
- India
- Indonesia
- Japan
- South Africa
- United Kingdom
- United States



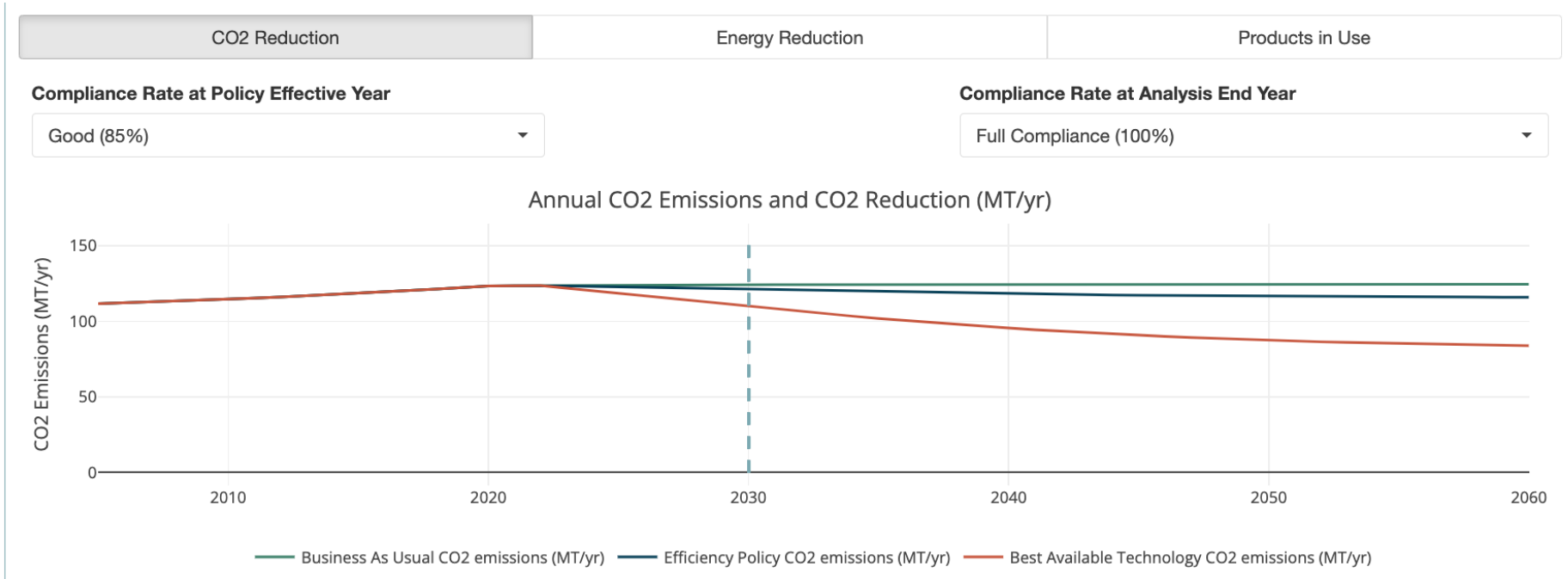


Mepsy *clasp.ngo/tools/mepsy*

The Appliance & Equipment Climate Impact Calculator

A dynamic, user-friendly tool to guide researchers and policymakers in identifying efficiency policy opportunities and their impacts.

- Preset & customizable data
- 8 appliances and 160+ countries
- Forecast impacts up to 2060
- Multi-country comparison



CPRC *clasp.ngo/tools/clasp-policy-resource-center*

Appliances and equipment energy efficiency policy hub

A global database of information on energy, water, and quality policies for on- and off-grid appliances and equipment.

- Over 1500 policies in 130+ economies
- Filter by 7 categories & 46 subcategories
- Quick map visualization
- Downloadable spreadsheets

Show Filters

153 RESULTS FOUND

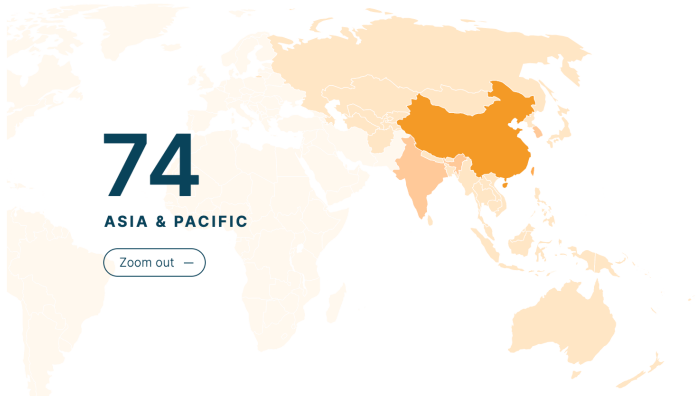
Asia and Pacific ✕ Lighting ✕ Clear filters

Show/Hide Columns Sort by Apply Download XLSX

POLICY	COUNTRY	PRODUCT TYPES	POLICY APPROACH	POLICY INSTRUMENT	ADOPTED	REVISED	UPDATED BY CLASP
Act on the Rational Use of Energy	Japan	Electronics, Information Technology, Computers, Audio-Visual, Televisions, Lighting, Space Heating and Space Cooling, Air Conditioning, Room ACs - Stationary ACs, Water, Water Heating	Mandatory	Minimum Performance Standard	1979	2018	October 2022

Minimum Performance Standard for Space Heating & Space Cooling

SUB-CATEGORIES: Air Conditioning (49) Space Heating (17) Ventilation (13) Reset Filters



Policies Per Economy 0 20+