



4^EPEET

PEET Efficiency Trends Analysis

Status of Room Air Conditioner Regulations

JULY 2022

Product Energy Efficiency Trends -
A project of the Energy Efficient End-use Equipment TCP

About 4E

The Technology Collaboration Programme on Energy Efficient End-Use Equipment (4E TCP), has been supporting governments to co-ordinate effective energy efficiency policies since 2008.

Fourteen countries and one region have joined together under the 4E TCP platform to exchange technical and policy information focused on increasing the production and trade in efficient end-use equipment. However, the 4E TCP is more than a forum for sharing information: it pools resources and expertise on a wide a range of projects designed to meet the policy needs of participating governments. Members of 4E find this an efficient use of scarce funds, which results in outcomes that are far more comprehensive and authoritative than can be achieved by individual jurisdictions.

The 4E TCP is established under the auspices of the International Energy Agency (IEA) as a functionally and legally autonomous body.

Current Members of 4E TCP are: Australia, Austria, Canada, China, Denmark, European Commission, France, Japan, Korea, Netherlands, New Zealand, Switzerland, Sweden, UK and USA.

Further information on the 4E TCP is available from: www.iea-4e.org

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Views, findings and publications of the 4E TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

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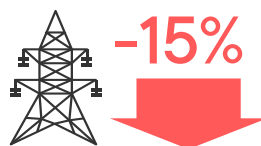
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Context

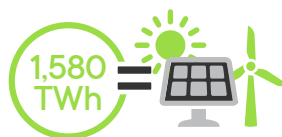
Since 2008, the Energy Efficient End-Use Equipment TCP (4E) has tracked the efficiency trends of major globally traded products and corresponding energy efficiency regulations. This enables 4E Members to identify whether their current policies are being effective, how these policies and the performance of products compares across different regions and opportunities for closer alignment.

This process forms a multi-lateral exchange between regulators within 4E Member countries that accelerates the development of product policies and increases the level of energy savings, while also reducing regulatory and cost burdens on industry and consumers.

Joint analysis by the IEA and 4E into the global impacts of energy efficiency regulations¹ has shown that:



The longest running energy efficiency (EES&L) programmes are estimated to deliver annual reductions of around 15% of total current electricity consumption.



In the nine countries/regions for which data were available, these programmes reduced annual electricity consumption by a total of around 1,580 terawatt-hours in 2018 – similar to the total electricity generation of wind and solar energy in those countries.



On average, the energy efficiency of new major appliances in countries with EES&L programmes has increased two to three times the underlying rate of technology improvement.



The average purchase price of appliances covered by EES&L programmes declined at a rate of 2–3% per year.

Within 4E economies, energy efficiency regulations, taken to include minimum energy performance standards (MEPS), mandatory and voluntary energy labelling in this report, are a key driver for product efficiency. Core elements of these regulations include:

- › The methods used to test and measure product performance
- › The metrics used to define energy performance or efficiency
- › The performance thresholds required by regulations

Since 2020, the 4E Product Energy Efficiency Trends (PEET) project has been monitoring the status of these elements across regulations for major appliance and equipment types across 4E Member countries.

¹ IEA/4E TCP (2021), Achievements of Energy Efficiency Appliance and Equipment Standards and Labelling Programmes, IEA, Paris (2021).
<https://www.iea.org/reports/achievements-of-energy-efficiency-appliance-and-equipment-standards-and-labelling-programmes>

Room Air Conditioners

This latest PEET report summarises the status of energy efficiency policy measures for **room air conditioners** within 4E economies.

Energy consumed by air conditioning systems has tripled since 1990: no other building end-use is growing as fast. Air conditioning not only makes up a significant and growing share of energy consumption, it is also the primary contributor to peak demand in many locations. Across the globe more than 60 countries have regulatory requirements on the energy performance of air conditioners that rely upon accurate and repeatable test procedures. However, the test procedures and metrics established by these different countries often vary, making it difficult to compare the energy performance of air conditioners across jurisdictions. This can confuse consumers, and provide inappropriate drivers for product developers, as well as increasing the testing burden on manufacturers attempting to comply with many different regulatory schemes. How energy efficiency policies continue to evolve in order to meet these challenges is the subject of workshops, papers and discussions held between 4E Members, which are summarised here.

This summary condenses many highly technical regulatory documents. However, to gain a thorough understanding, it should not replace consideration of these regulations.

This report describes the main types of room air conditioners and explains the coverage of energy efficiency standards and labelling (EES&L) programmes by type of unit within 4E economies. It concludes with a brief summary of the major trends and opportunities for the regulation of room air conditioners.



Room Air Conditioner Types

In this report, we focus on room air conditioners (AC) with an upper cooling capacity limit of 14 kW that use the vapor compression cycle designed to provide comfort cooling (and/or heating) to one or more rooms, but not a whole building. These products can be:

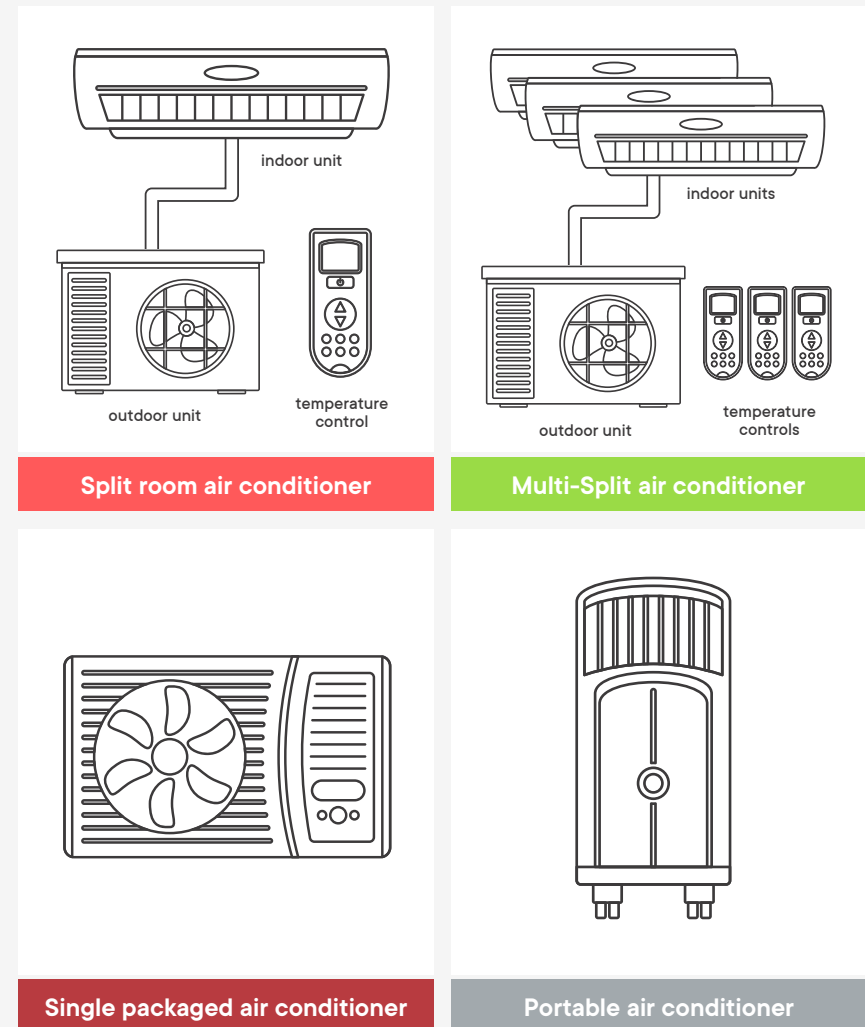
- › Air to air, air to water or water to water
- › Cooling only or reversible i.e. can provide heating (also referred to as heat pumps)
- › Fixed capacity or variable capacity²

The terminology for the main types of air conditioners varies across 4E jurisdictions. In this report we are mainly interested in the following types:

- › Split room air conditioners
 - ›› also known as single split-packaged or mini-splits
- › Multi-split air conditioners
 - ›› a split AC type with a single outdoor unit and multiple in-door units
- › Single packaged (unitary) air conditioners
 - ›› sometimes called “through the window”, or “through the wall” air conditioners
 - ›› in North America are called “room air conditioners”
 - ›› in Korea called “integrated” air conditioners
- › Portable
 - ›› single-duct air conditioners
 - ›› double-duct air conditioners

A glossary is provided at the end of this report to explain the terminology used.

² In practice variable capacity units use variable speed compressors and fixed capacity units use single (or fixed) speed compressors



Coverage of Regulations

Table 1 shows the coverage of MEPS and mandatory labelling for the main types of domestic air conditioners in 4E economies.

- > All 4E economies have MEPS and energy labelling requirements in place for reversible split AC units
- > All 4E economies except Japan have MEPS and energy labelling requirements in place for single-packaged (window/wall) room AC and cooling only split room AC
- > All 4E economies except China, Japan and Korea have MEPS and energy labelling requirements in place for portable room AC
- > All 4E economies except China and Japan have MEPS in place for multi-split room AC

Table 1: Coverage of EES&L programmes for the main types of domestic air conditioners within 4E economies

	MEPS				Mandatory Energy Labels			
	Split	Single packaged	Portable (single and double duct)	Multi-split	Split	Single packaged	Portable (single and double duct)	Multi-split
Australia	✓	✓	✓	✓	✓	✓	✓	
New Zealand	✓	✓	✓	✓	✓	✓	✓	
Canada	✓	✓	✓	✓	✓	✓	✓	✓
USA	✓	✓	✓	✓	✓	✓	✓	✓
China	✓	✓			✓	✓		
EU	✓	✓	✓	✓	✓	✓	✓	✓
Switzerland	✓	✓	✓	✓	✓	✓	✓	✓
UK	✓	✓	✓	✓	✓	✓	✓	✓
Japan	✓				✓			
Korea	✓	✓		✓	✓	✓		✓

Notes

- ✓ Black tick indicates that all sub-types are included
- ✓ Red tick indicates that cooling-only types are not included

Test Methods

Test standards are used to measure air conditioner performance at specified test conditions and rating standards are applied to present aggregate energy performance metrics. All 4E economies use a test method that is aligned with the ISO standard: ISO 5151:2017 *Non-ducted air conditioners and heat pumps – Testing and rating for performance*.

Therefore, the measurement and rating of full-load energy performance of non-ducted units in the cooling or heating mode is the same in all 4E economies.

However, there are differences between 4E economies in the test points required for determining part-load performance for related metrics. These are shown in Table 2.

Table 2: Part-load test points in 4E economies

	Part-load test conditions in cooling mode	
	No. load points	Share of full load
Australia	3	100%, 50% and optional at minimum
New Zealand		
Canada	4	100%, 75%, 50%, 25%
USA		
China	3	100%, Intermediate, 25%,
EU		
Switzerland	4	100%, 74%, 47%, 21%
UK		
Japan	3	100%, Intermediate, 25%,
Korea	3	100%, Intermediate, 25%,

Energy Efficiency Metrics

Table 3 summarises the energy performance metrics used in 4E economies for regulatory performance thresholds for non-portable units.

It should be noted that:

- > All 4E economies use weighted part load energy performance metrics for split air conditioners, mostly regardless of the product type
- > Australia/New Zealand and Canada/USA do not use weighted part load energy performance metrics for MEPS for single-packaged (window/wall) types
- > For energy labels only Canada/USA rate performance of single-packaged units at full load
- > For reversible units some 4E economies use an aggregate APF metric for MEPS and labelling while others set MEPS & labelling requirements separately for the cooling and heating modes and hence rate and report their performance separately.

Table 3: Summary of air conditioner performance metrics used in 4E economies for non-portable units

	Energy Efficiency Metric					
	EER/COP ¹	SEER ²	CSPF ³	HSPF ⁴	SCOP ⁵	APF ⁶
Australia	✓		✓	✓		
New Zealand	For MEPS		For labelling	For labelling		
Canada	✓					
USA	For single packaged	✓		✓		
China		✓		✓		✓
EU						
Switzerland		✓			✓	
UK						
Japan			✓	✓		✓
Korea			✓			

Notes

- 1 Energy Efficiency Ratio (EER) for cooling and Coefficient of Performance (COP) for heating
- 2 Seasonal energy efficiency rating
- 3 Cooling seasonal performance factor
- 4 Heating seasonal performance factor
- 5 Seasonal coefficient of performance
- 6 Annual performance factor

Product Categories

All countries have different regulatory requirements for non-portable types, depending on the cooling capacity of the unit, although this is not always reflected in the labelling requirements.

In addition, regulatory requirements may also vary according to the following attributes, as shown in Table 4:

- > Whether it is cooling only or reversible (i.e. can also provide heating)
- > Whether it is variable or fixed capacity
- > Whether it is single or split packaged unit
- > Whether it is a single-split or multi-split unit
- > Other factors

Table 4: Treatment of product attributes for room air conditioners within regulations in 4E economies

	Cooling capacity		Cooling only or reversible		Variable or fixed capacity		Single packaged or split		Single-split or multi-split		Other	
	MEPS	Labels	MEPS	Labels	MEPS	Labels	MEPS	Labels	MEPS	Labels	MEPS	Labels
Australia & New Zealand	✓						✓		✓			
Canada & USA	✓	✓	✓	✓			✓	✓				Louvres/ Casements
China	✓	✓	✓	✓	✓	✓						
EU, Switzerland	✓						✓					Refrigerant GWP
Japan	✓	✓										Home or business use
Korea	✓	✓					✓	✓				

Notes

An empty cell indicates that there is no difference in regulatory requirements by that parameter

IN SUMMARY:

- > Some 4E economies differentiate MEPS and labelling thresholds for cooling only or reversible units but most do not
- > Only China distinguishes MEPS and label thresholds between fixed and variable capacity units
- > Some 4E economies differentiate MEPS requirements between single-packaged and split units but some don't; even less do so for energy labelling
- > Only the US & Canada differentiate MEPS and label requirements for single-packaged units (window/wall) between louvers or casements
- > Only Europe distinguishes MEPS thresholds as a function of refrigerant GWP
- > Only Japan distinguishes Top Runner and labelling thresholds as a function of the user (home or business).

Trends

The following 4E economies have updated their regulatory requirements recently:

Australia and New Zealand have adopted new MEPS and labelling requirements that came into effect in April 2020³ and July 2021⁴



China has also adopted new MEPS and energy labels requirements that came into effect in July 2020



Korea has adopted new MEPS and labelling requirements that came into effect in October 2021



United States and Canada have adopted new MEPS for central AC and heat pumps (including split AC room air conditioners) which take effect from January 2023; and new MEPS for portable air conditioners that will come into force in October 2025



Japan will publish a new Top Runner target for air conditioners in 2027. It is likely that there will be some changes to the current test method including the provision for different climate zones.

The changes published by the US in January 2017 for Central Air Conditioners (CAC) and Heat Pumps (HP) aim to make the test procedure better reflect actual on-site performance. This will require new testing and rating of all units by January 2023. The regulation also increases the stringency for split system central air conditioners/heat pumps, which represent the large majority of current shipments in this market (9.3m units in 2020).

Like the previous version of the US regulation, the performance requirements include regional variations, with the country split into 3 regions. Minimum performance requirements apply nationally to all manufactured and imported products, and more stringent requirements apply to products installed in the Southwest and Southern region.

Other countries are using energy labels to encourage the installation of models in suitable climate zones. The introduction of the 'Zoned Energy Rating Label' for air conditioners in Australia and New Zealand provides both heating and cooling energy performance information for each unit in all of 3 climate zones across the two countries. While this new label contains a considerable amount of information, it appears to be well understood by consumers.

A combined heating and cooling metric for reverse cycle air conditioners is one way to minimise the quantity of information on a label. However, the 'averaging' of performance data reduces the usefulness of the label for consumers that want to optimise either heating or cooling performance depending on their climate zone and is therefore not generally used within 4E economies.

There are number of future improvements under consideration, including the use of a QR code within energy labels as a means of providing additional information.

The EU is revising air conditioner MEPS and energy labelling regulations⁵. The EU is also examining the feasibility of a single label for all local heating appliances, including heat pump air conditioners, based on primary energy to enable consumers to compare performance of units across all fuels and types. It is likely that this will include performance information for three climate zones.

³ In Australia

⁴ In New Zealand

⁵ See https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13358-Energy-efficiency-ecodesign-rules-for-air-to-air-conditioners-air-to-air-heat-pumps-and-comfort-fans-review_en

Glossary

The following terminology is used in this report.

AC	Air conditioner	PEET	Product Energy Efficiency Trends project under the 4E TCP
APF	Annual performance factor	QR code	Quick response code. A two-dimensional version of the barcode able to convey a wide variety of information by scanning with a mobile device
COP	Coefficient of performance	Rating	The set of rated values and operating conditions
CSPF	Cooling seasonal performance factor	Rated value	A quantity value assigned, generally by a manufacturer, for a specified operating condition
EER	Energy efficiency ratio	SCOP	Seasonal coefficient of performance
GWP	Global-warming potential. Describes the relative potency of a greenhouse gas, taking account of how long it remains active in the atmosphere	TR	Top Runner Programme in Japan
HSPF	Heating seasonal performance factor	UEC	Unit energy consumption
IEA	International Energy Agency		
IEC	International Electrotechnical Commission		
ISO	International Organization for Standardization		
MEPS	Minimum energy performance standard		
NA	Not available (or applicable)		