

Task Force 02

SUSTAINABLE CLIMATE ACTION AND INCLUSIVE JUST ENERGY TRANSITIONS

Promoting Highly Efficient Appliances for Climate Change Mitigation and Social Inclusion

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Abstract

The appliance sector is responsible for 39.3% of all energy-related CO₂ emissions, equivalent to the combined emissions of China, Europe, and Brazil in 2020. Developing countries have significantly lower access to appliances compared to G20 economies. Therefore, promoting highly efficient appliances is critical not only for climate change mitigation but also for adaptation, and social inclusion – requiring ambitious support from major economies. Even if current benchmark appliance efficiency policies were adopted worldwide, the sector's emissions would still exceed the IEA's 2050 net-zero target by at least 7 GT. As primary manufacturer and largest consumers of appliances, G20 must urgently take action to promote highly efficient appliances while simultaneously addressing the inequitable gaps in appliance access. Considering these circumstances, we recommend to G20 countries ambitious, yet currently feasible, energy efficiency policies: increase energy Standards and Label (S&L) policy ambition to promote market transformation toward highly efficient products; lead joint initiatives for regional harmonization of standards & labels; implement coordinated and complementary actions to assure market development, affordability, and social inclusion. CLASP has identified ten key appliances that must be targeted by a G20 joint strategy to rapidly enhance their energy efficiency. If those policies were implemented by 2025 for the key appliances sector, G20 countries (as whole) could achieve energy savings of 54,974 TWh and a reduction in cumulative CO₂ emissions by 20.8 GT by 2050. Brazil, with a large market and a significantly outdated appliance industry compared to even other developing countries, should seize the opportunity, as the current leader of the G20, to propel it forward.

Keywords: appliances, energy efficiency, climate change, market transformation, social inclusion.

Diagnosis of the Issue

There are currently 10 billion appliances in use, and this number continues to rise. Billions of people benefit from using appliances for their wellbeing, productivity, and – increasingly – coping with global warming and its associated hazards. However, appliances have a major climate impact and current efforts to expand access are insufficient.

Applying MEPSY tool, CLASP estimates the appliance sector is responsible for 39.3% of all energy-related CO₂ emissions, equivalent to the combined emissions of China, Europe, and Brazil in 2020. Notably, the G20 countries account for 82% of global appliance energy consumption (Table 1).

TABLE 1 – Energy consumption by appliances – in TWh

	G20	Global	%
Air conditioner	1442	1968	73%
Beverage Cooler	71	82	87%
Ceiling and Portable Fans	259	392	66%
Transformers	1265	1553	81%
Motor	11414	13749	83%
Lighting	2844	3382	84%
Refrigerator	818	1122	73%
Water heater	1625	1859	87%
Space Heating	8914	10607	84%
Television	292	386	76%
Total	28944	35101	82%

Source: elaborated by the authors applying [MEPSY - CLASP](#).

If current trends in energy consumption and carbon emissions persist, appliances will surpass the International Energy Agency Net Zero Emissions (NZE) mitigation target by at least 9 Gt of CO₂ in 2050 (IEA, 2021). Even if countries universally adopt current

global benchmark appliance efficiency policies, emissions in 2050 would still exceed the NZE mitigation target by at least 7 Gt of CO₂, according to the estimations made by CLASP.

Apart from the fact that 745 million people still do not have access to electricity (IEA, 2023), developing countries face substantially lower access to appliances compared to advanced economies. Cooling and refrigeration are still considered luxuries in many places: 1.2 billion people do not have access to an air conditioner or fan to keep cool under sweltering conditions, while 1.7 billion lack access to a refrigerator-freezer to preserve food, according to CLASP estimations. In other words, 3.6 billion people living in regions highly vulnerable to climate change, such as sub-Saharan Africa, and South and Southeast Asia, may lack access to essential appliances necessary for adapting to a warming world.

The decisions made by G20 governments and manufacturers regarding the products entering global markets over the next five years will profoundly affect the appliance sector's ability to achieve NZE targets. Furthermore, these choices will directly impact the accessibility of appliances for the world's most vulnerable populations.

G20 countries play a significant role in global appliance manufacturing, including producing 91% of refrigerators and 85% of air conditioners in 2023¹. The 10 largest appliance manufacturers, responsible for designing, producing, and distributing appliances used worldwide, are based in G20 countries like Korea, Japan, China, the United States, and the European Union (specifically Germany, Sweden, France, and Italy). Although most of these companies have the capability to manufacture highly

¹ Data collected from Euromonitor International data base on March 18, 2024.

efficient equipment, they often choose to saturate overseas markets with less efficient models, especially when national regulations are less strict.

Governments can shape markets by defining ambitious and stringent appliance efficiency policies. Subsequently, G20 countries must play a pivotal role in enhancing the efficiency and affordability of appliances. Some policies adopted by certain G20 members set benchmarks for the rest of the world such as some minimum energy performance standards (MEPS) for energy using appliances implemented by the EU, the UK, China, US, Canada, and Japan (Mavandad & Malinowski, 2022).

On the other hand, certain policies in force in certain G20 countries still fall short of the best international standards. For example, Brazilian policies for refrigerators lag many other countries. Even with recent updates, the MEPS in 2027 for the most common types of refrigerators sold in Brazil² will allow for products that consume more than 80% more electricity than would be allowed under the MEPS in the Southern African Development Community (SADC)³. This higher electricity consumption translates into higher electricity bills, costing the average Brazilian consumer over US\$200 more in lifecycle costs, according to CLASP's analysis.

² The current regulation on Brazilian refrigerator MEPS was published on November 23rd, 2023. The regulation is available at Diário Oficial da União (2023).

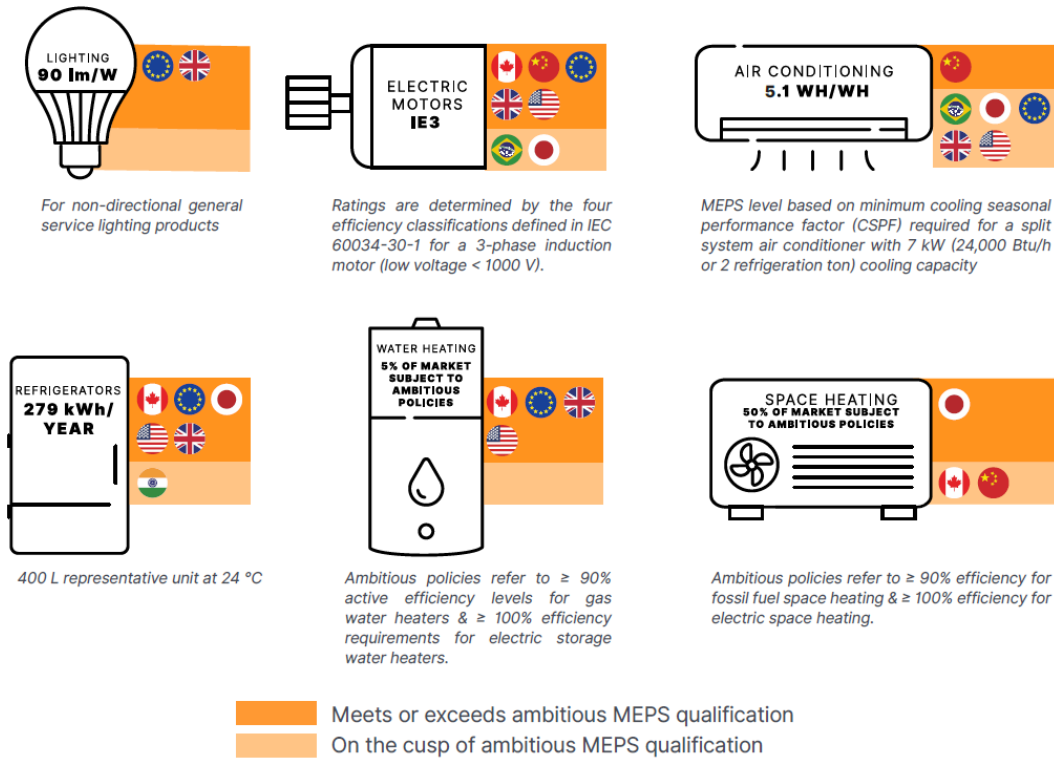
³ SADC includes Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, United Republic of Tanzania, Zambia, and Zimbabwe. More information MEPS approved by SADC region may be found in U4E (2024).

(i) Increase energy Standards and Label (S&L) policy ambition to promote market transformation toward highly efficient products

S&L policies are critical tools for achieving ambitious climate mitigation and social inclusion goals. While MEPS eliminate the most inefficient products in a market, labels reduce information barriers for consumers, encouraging purchases based on lifetime costs. Such programs have been proven to be scalable and cost-effective, boosting energy efficiency, and increasing energy savings whilst supporting market transformation and sustainable economic growth.

The World's Best MEPS summarized by CLASP identifies the most ambitious policies for the six highest energy using appliances categories (Figure 2) across ten G20 countries: United States, United Kingdom, Canada, China, Brazil, India, EU, Indonesia, Japan, South Africa. The benchmarks in this tool should drive ambition in G20 economies with less stringent MEPS.

FIGURE 2 – World’s Best MEPS for highest energy using appliances



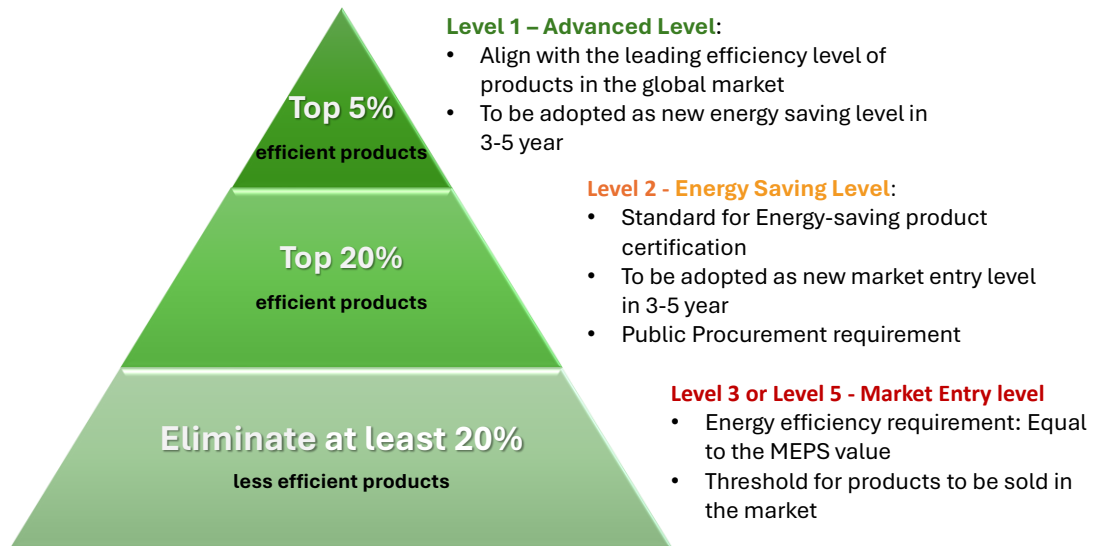
Source: elaborated by the authors applying [MEPSY - CLASP](#).

Additionally, the G20 countries whose current regulations fall short in this regard, should further enhance their regulatory framework to drive continuous market transformation toward higher efficiency products. At the minimum, G20 should ensure standards and labels are in line with international levels such as those specified in United for Efficiency (U4E)’s Model Regulation Guidelines.

The China Energy Efficiency Standard & Label Regulation, revised in 2022, serves as an illustrative policy that encourages active monitoring and updating product energy efficiency parameters. As shown in Figure 3, it sets clear targets for the three (or, occasionally, five) levels on the China Energy Label as well as the MEPS level. Reviews of each S&L policy are conducted every five years to keep up with market transformation.

Once initiated, the revision of S&L policies must be completed within eighteen months to avoid product obsolescence.

FIGURE 3 - China Energy Efficiency Standard & Label Regulation



Source: adapted by the authors from CLASP (2023).

However, the global adoption of current benchmark appliance efficiency policies is still insufficient and would lead the sector’s emissions to still surpass the IEA’s 2050 net-zero target by at least 7 Gt. To achieve the ambitious net zero targets, G20 economies must intensify their efforts significantly, as suggested in Table 2.

TABLE 2 - Actions to be taken by G20 economies to reach Net Zero Targets

Appliance	Efficiency Targets
LED Lighting	Completely phase out fluorescent and incandescent lighting by 2025
	Double the luminous efficacy of new LEDs by 2030 to take advantage of rapid technological improvement
Air Conditioners	Double the efficiency of new units
	Transition to low GWP refrigerants in accordance with the Kigali Amendment to the Montreal Protocol
Refrigerators	Double the efficiency of new units by 2030
Electric Motors	Double the efficiency of new industrial motor systems by 2030
	Greatly accelerate the replacement of existing stock by 2030 to achieve full replacement with the most efficient motors (IE5)
Heat Pumps	Stop sales of fossil fuel equipment to fully transition stock to heat pumps by 2050
Heat Pump Water Heaters	Stop sales of fossil fuel equipment to fully transition the stock of storage water heaters to heat pumps and solar thermal by 2040

Source: elaborated by the authors applying [MEPSY - CLASP](#).

ii) Lead joint initiatives for regional harmonization of standards & labels

G20 economies must redouble their efforts in developing and harmonizing energy-efficient regulation, given their critical role as consumers and manufacturers of appliances. And Brazil, as current leader of G20, should seize this opportunity spearheading a joint initiative for the harmonization of standards and labels.

Regional blocs and international fora should strive for harmonization of appliance standards and labels within their regions, along with cross-border cooperation in market surveillance. These efforts serve two simultaneous goals:

- Elevating the energy efficiency parameters of G20 countries that lag international standards.
- Preventing the influx of substandard appliances and avoiding the dumping of low-quality products in low-income markets.

Uniform guidance across importing and exporting markets can send clear signals to manufacturers that inefficient appliances are no longer acceptable. To further promote and lead the harmonization of labels and MEPS, G20 should mandate that all exports from their countries meet their existing domestic requirements.

Appliance manufacturers should cease producing appliances that fail to meet minimum standards in their countries of origin and exporting them to markets with less stringent regulations. Instead, they should leverage their influence to advocate for the sale of more energy-efficient appliances worldwide.

iii) Implement coordinated and complementary actions to assure market development, affordability, and social inclusion

To broaden the impact of S&L policies and to address the disparities in appliance access, governments should adopt a comprehensive set of policies aligned with energy efficiency criteria. These policies serve a dual purpose: facilitating the penetration of next-generation technologies into the market and reducing the access gaps for low-income population.

- *Public Procurement:* G20 governments can lead by example by procuring energy-efficient appliances for public institutions. Public procurement accounts for approximately 12%-30% of gross domestic product (GDP). The Brazilian government, for instance, which spends USD 100 million annually⁴ only in air-conditioners does not require any energy efficiency criteria for public procurement.

⁴ Data collected from [Painel de Preços](#) data base on January 20, 2024.

▪ *Bulk Procurement*: governments and companies in the G20 can set ambitious technical specifications based on the best available technology in the market and, through a bidding process, procure such appliances in bulk at lower prices. These programs aggregate demand for highly efficient appliances, establishing a clear market for manufacturers, leading to reduction in prices through economies of scale. When coupled with awareness raising programs, such programs can accelerate the deployment of new technologies.

▪ *Financial incentives*: rebates, subsidies, tax incentives and results-based financing that are coupled with efficiency standards and labels drive long run growth of energy efficient appliance markets. Such programs can be applied both upstream to manufacturers and downstream to consumers and can be rolled out in collaboration with different entities including energy providers such as utilities and energy service companies. In areas where there are issues with access to grid electricity, these incentives can also target solar home systems paired with efficient appliances to offer a comprehensive solution to provide modern energy services. Financial incentives are particularly important for closing the affordability gap for low-income consumers who may not otherwise be able to afford an appliance.

▪ *Financing Schemes*: low-interest loans to consumers and businesses for purchasing energy-efficient appliances, besides making energy-efficient appliances more accessible, motivate consumers to choose these products. These schemes can reduce the upfront cost barrier while simultaneously encouraging adoption of new technologies.

Such actions would also promote a market transition toward high-quality, affordable energy-efficient appliances by opening markets, lowering cost barriers, and raising awareness across the supply chain, ultimately benefiting consumers, manufacturers, and the planet.

Scenario of Outcomes

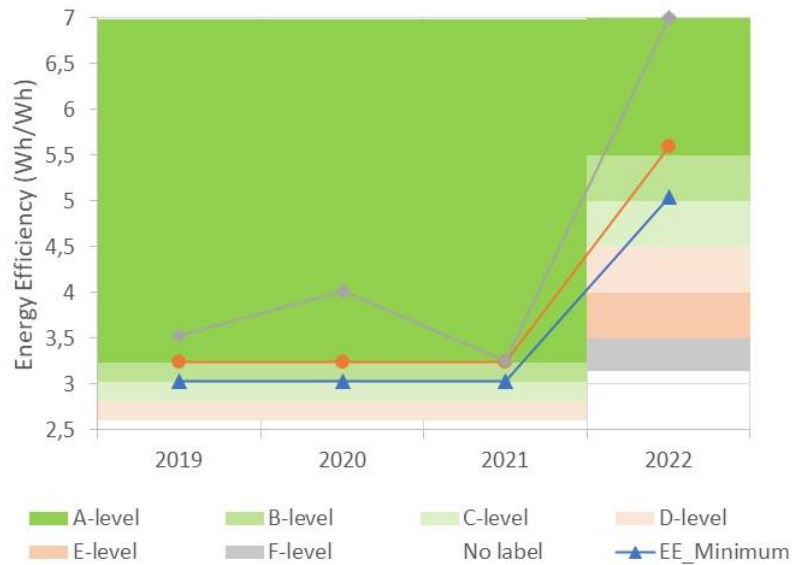
The *Strategic Plan for Advancing Energy Efficiency Across Demand Sectors by 2030*, prepared by G20 2023 India has already emphasized that implementing appropriate MEPS for all appliances could lead to a 25% reduction in overall energy consumption by 2030. Appliances accounts for 26.3% of the required reduction from the 2020 global energy-related 35 Gt of CO₂ emissions to meet the IEA's ambitious NZT goals.

Coordinated actions by G20 governments and manufacturers are urgently needed. If ambitious, yet currently feasible, energy efficiency policies were implemented in 2025, CLASP estimates that the appliance sector from G20 countries (as whole) could achieve energy savings of 54,974 TWh and a reduction in cumulative CO₂ emissions by 20.8 GT by 2050. To estimate the major outcomes of the recommended actions, CLASP has modeled the impacts of ten most consumed appliances by G20 countries using [MEPSY - CLASP](#): air conditioner, beverage cooler, ceiling and portable fans, motor, lighting, refrigerator, water heater, space heating and television.

Kelpsaite et. al. (2023) has also investigated the widespread sale of less efficient air conditioners across Southeast Asia by multinational companies, which manufacture high-efficiency models for their domestic markets. By eliminating this practice of dumping, countries in the region could reduce over 1 GT of CO₂ emissions over 25 years.

The significant impact achieved by certain national policies demonstrates the feasibility of the recommended actions, for G20 countries that manufacture appliances. For instance, the Brazilian air conditioner labeling policy revision in 2020 resulted in a swift market transformation (as depicted in Figure 4) – while preventing 21.5 million metric tons of CO₂ emissions cumulatively by 2030.

FIGURE 4 – Energy Efficiency Distribution of Registered Split AC Models in Brazil (2019-2022)



Source: elaborated by the authors using Label Brazilian Program (PBE) registry database from Inmetro⁵

Similarly, S&L policies from India’s Bureau of Energy Efficiency have resulted in a 3.5% reduction in India’s energy consumption and the avoidance of over 306 MT of CO₂ emissions annually, thereby enabling India to achieve its Nationally Determined Contributions (NDC) target eleven years ahead of schedule (India Ministry of Power, 2024).

CLASP estimates that universal access to, or ownership of, ten essential appliances (lighting, air conditioners, fans, refrigerators, heat pumps, e-cooking, mobile phones,

⁵ Available at: <https://www.gov.br/inmetro/pt-br/assuntos/avaliacao-da-conformidade/programa-brasileiro-de-etiquetagem/tabelas-de-eficiencia-energetica/condicionadores-de-ar>

televisions, radios, and solar water pumps) can help deliver 12 of the 17 UN Sustainable Development Goals. Fans, for instance, provide a low-cost and energy-efficient means of cooling during heat waves, reducing the risk of heat stroke and other heat-related illnesses. The use of e-cooking appliances reduces the burden of unpaid labor, mostly for women and children, avoiding the need to collect fuelwood for cooking or take frequent trips to the market, allowing additional time for educational, income generating, or leisure activities.

The outcomes of some national initiatives such as India's Unnat Jyoti by Affordable LEDs for All (UJALA) scheme illustrates how some actions can simultaneously help the next generation technologies penetrate the market and to reduce the appliances access gaps for low-income population. Launched in 2015, the program promotes the use of energy-efficient LED bulbs to replace traditional incandescent and compact fluorescent lamp (CFL) bulbs.

By procuring in bulk, EESL was able to make LED bulbs more affordable to consumers through a demand aggregation model. LED bulbs are distributed to households at subsidized rates, making them affordable and accessible to all. From 2012 to 2016, LED retail market prices dropped from roughly 800 Indian Rupees (INR) per LED bulb to 200 INR per LED bulb—one of the fastest LED price reductions in the world. As of June 2023, the program had distributed over 368 million LED bulbs, mitigating 38 MT of CO₂ per year, and saving households 192 billion INR [\$2.3 million USD] on their energy (Thapa, 2023).

With the combination of recommended S&L policies and market transformation programs, the G20 can simultaneously make progress towards 12 sustainable development goals while making immediate, cost-effective CO₂ emissions reductions.

These outcomes will bring the world much closer to mitigating catastrophic climate change while ensuring everyone can access modern energy services.

However, it is worth noting that robust monitoring and evaluation (M&E) implementation is vital to assess the outcomes, effectiveness, and impact of energy efficiency policies and programs. This is especially crucial in countries like Brazil, where energy efficiency governance faces challenges in terms of coordination, M&E capacity, and inadequate human resources within key governmental institutions.

References

CLASP. “Summary of Recent Policies on China’s Energy Efficiency Standard Rescaling and Upgrading”. Washington DC, United States: CLASP, March 22, 2023.

DIÁRIO OFICIAL DA UNIÃO. Resolução N°. 2, de 23 de novembro de 2023: “Aprova o Programa de Metas para Refrigeradores e Congeladores”. Publicado em 08/12/2023, Edição 233, Seção 1, Página 218. <https://www.gov.br/mme/pt-br/assuntos/ee/cgiee-1/Resoluono.2de2023.pdf>

IEA, “Net Zero by 2050: A Roadmap for the Global Energy Sector.” Paris, France: International Energy Agency, 2021. <https://www.iea.org/reports/net-zero-by-2050>

IEA. “Access to electricity improves slightly in 2023, but still far from the pace needed to meet SDG7”. Paris, France: International Energy Agency, 2023.

<https://www.iea.org/commentaries/access-to-electricity-improves-slightly-in-2023-but-still-far-from-the-pace-needed-to-meet-sdg7>

India Ministry of Power, “BEE has helped India to reduce its energy consumption by around 3.5%, and to reduce its carbon emissions by 306 million tonnes per annum”.

Union Power and New & Renewable Energy Minister R. K. Singh, 2024. Posted On: 01 MAR 2024 2:14PM by PIB Delhi.

<https://pib.gov.in/PressReleasePage.aspx?PRID=2010550>

Kelsaite, L., Webber J., Dubytz, K., and Mavandad, S. “Pathways to Prevent Dumping of Climate Harming Room Air Conditioners in Southeast Asia”. CLASP, 2023.

<https://www.clasp.ngo/research/all/pathways-to-prevent-dumping-of-climate-harming-room-air-conditioners-in-southeast-asia/>

Mavandad, S. and Malinowski, M., “World’s Best MEPS: Assessing Top Energy Efficiency Standards for Priority Appliances”. Washington DC, United States: CLASP, 2022. <https://www.clasp.ngo/research/all/worlds-best-meps/>

MEPSY – CLASP, “The Appliance & Equipment Climate Impact Calculator”. <https://www.clasp.ngo/tools/mepsy/>

Thapa, Bishal, “Why India’s LED revolution is a case study in energy market transformation”. ETEnergyworld, August 11, 2023. <https://energy.economictimes.indiatimes.com/news/power/why-indias-led-revolution-is-a-case-study-in-energy-market-transformation/102645678>

U4E. “Harmonized Regional MEPS for air conditioners and residential refrigeration appliances approved for the SADC Region”. February 20, 2024. <https://united4efficiency.org/harmonized-regional-meps-for-cooling-products-approved-for-sadc-region/>



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