



Doubling Energy Efficiency for Room Air Conditioners

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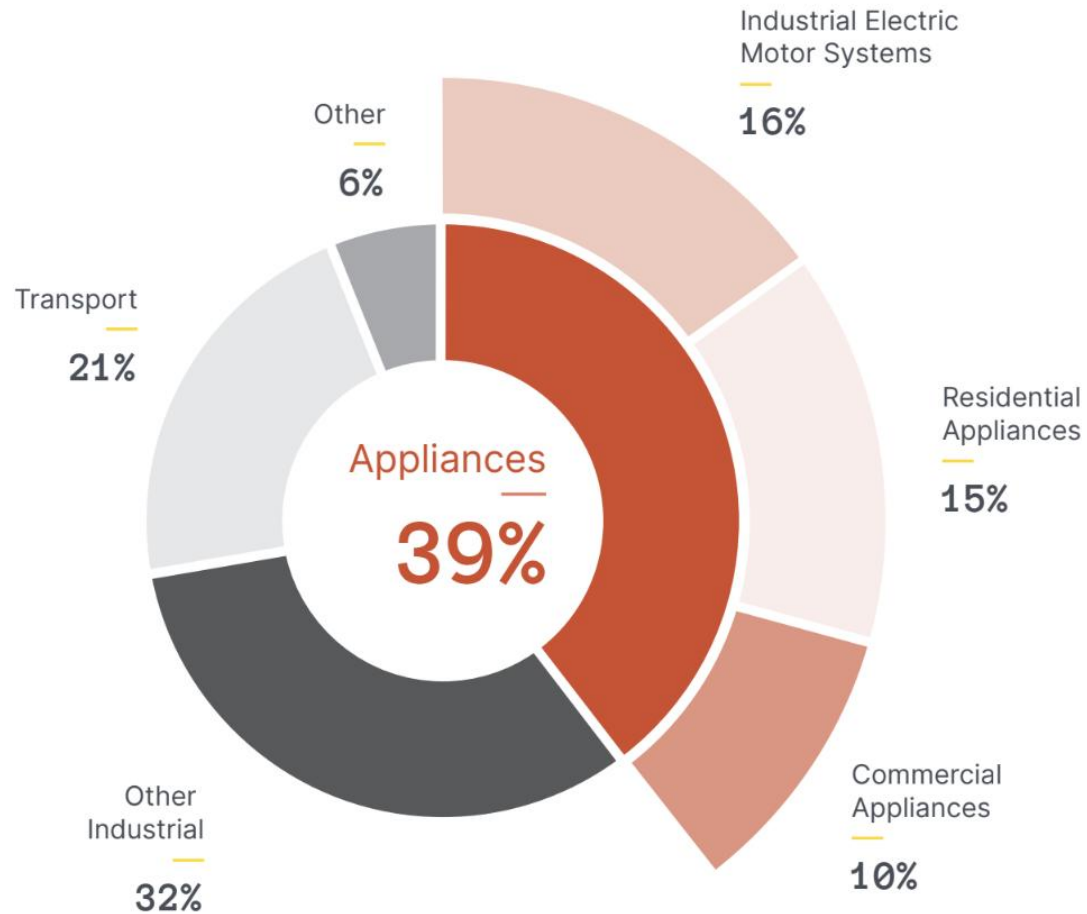
Efficient Appliances for People & the Planet



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

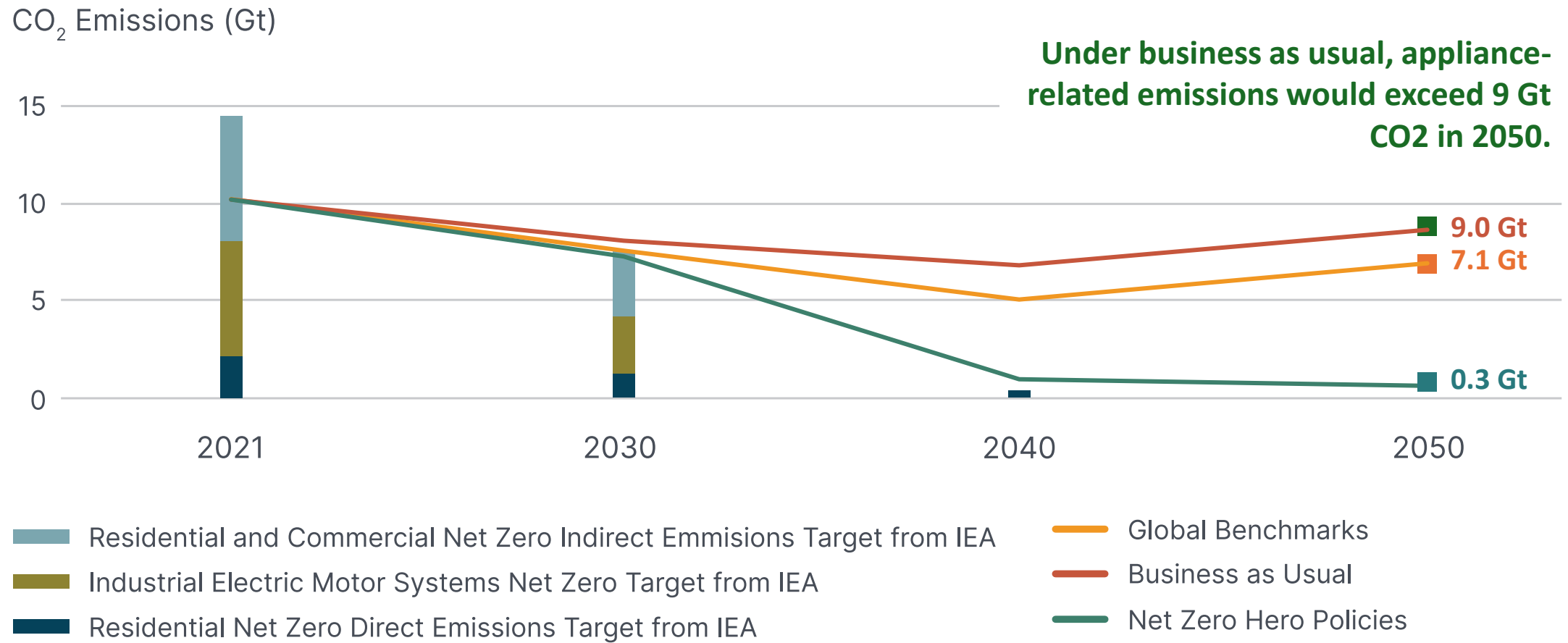
MISSION

Appliances are major contributors to climate change and have a large role to play in energy intensity improvement rates



Appliances are responsible for **39% of energy-related CO₂ emissions.**

How can net zero emissions be achieved in the appliance sector?



Net zero appliance targets are ambitious, but not out of reach

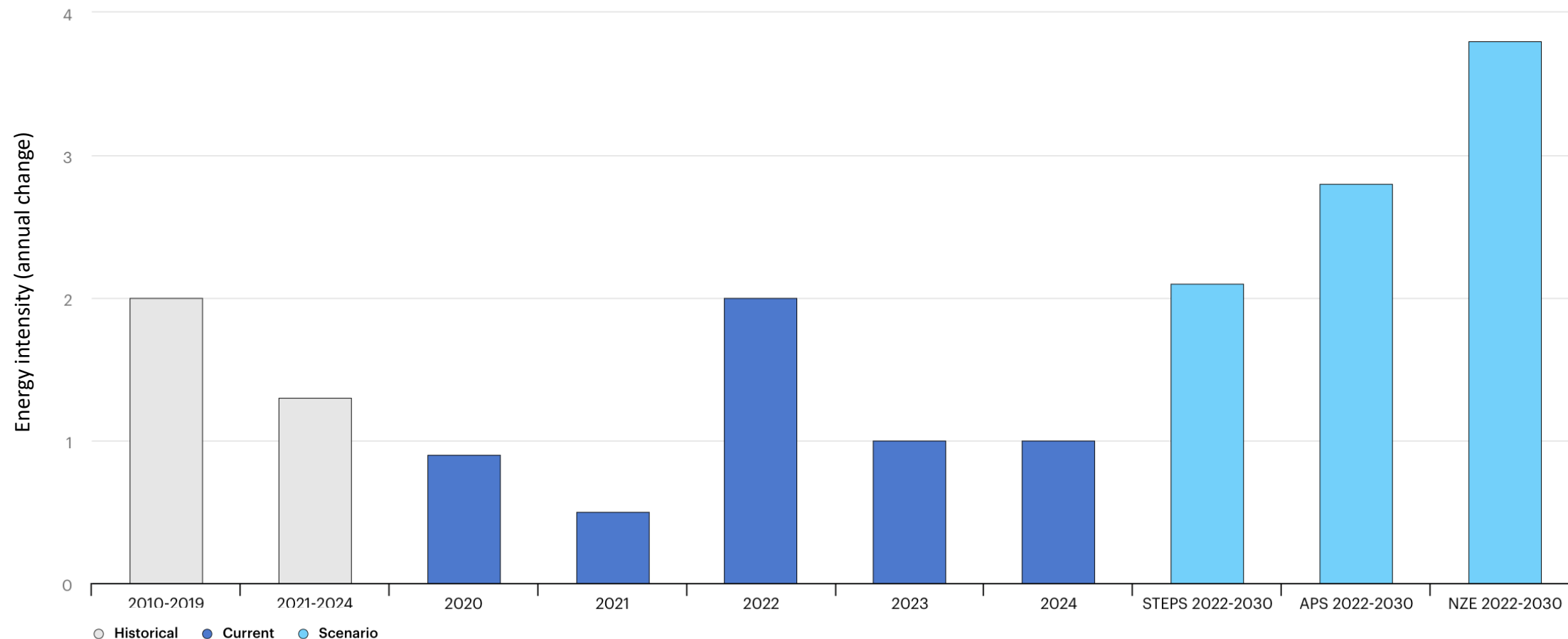
Doubling efficiency improvement to above 4% per annum to align with the IEA’s Net Zero Scenario

To achieve, net zero emissions in the appliance sector, efficiency policies and programs must be **funded, implemented, and scaled** at a rate never seen before.

Appliance	Target
Lighting	Fully transition to LED lighting by 2030
Air Conditioners	Double the efficiency of new units by 2030
Refrigerator-Freezers	Double the efficiency of new units by 2030
Fans	Require the use of permanent magnet motors in new units by 2025
Heat Pumps	Full stock transition by 2050
Water Heaters	Full stock transition to heat pumps by 2050
Motors	Double system efficiency by 2030
Cooking	Full stock transition to electric cooking
TVs	Exceed current EU regulations by 13% by 2025
Water Pumps	Fully transition to electric water pumps for irrigation

We are not on track to achieve the global doubling goal

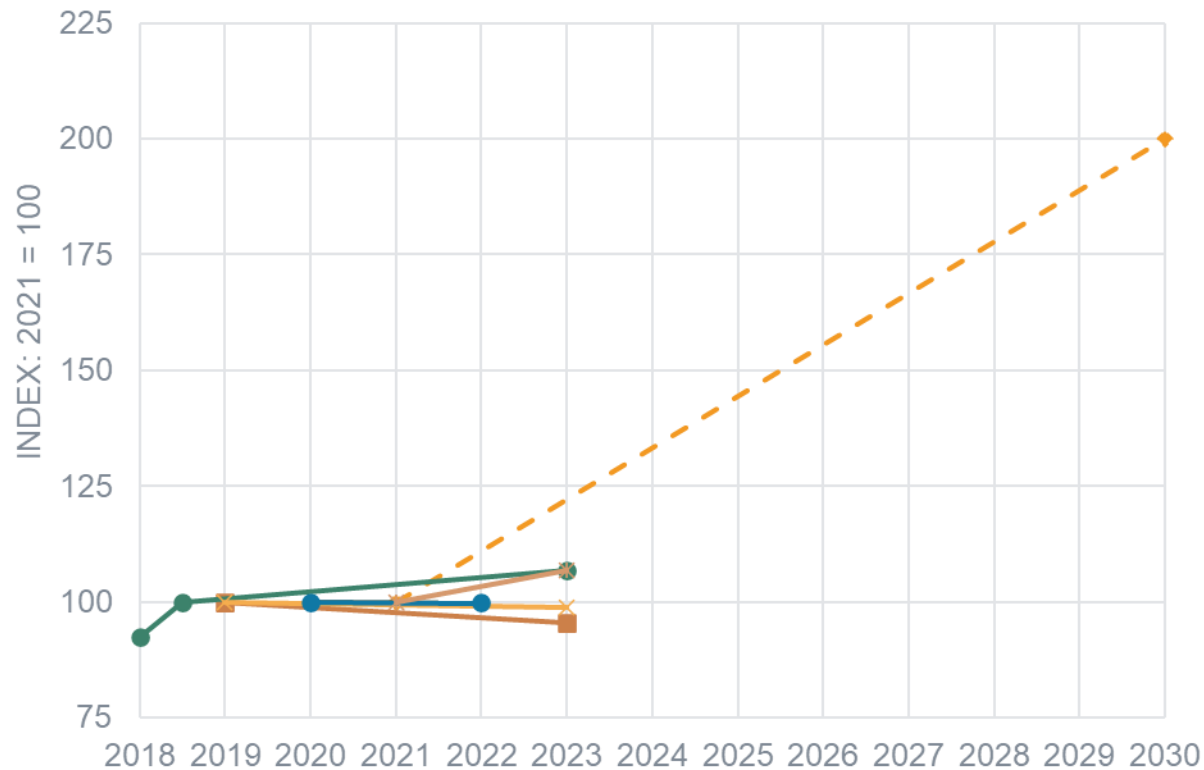
Global annual improvement in primary energy intensity, 2010-2024e, and by IEA scenario, 2022-2030



IEA. "Energy Efficiency 2024." IEA, 2024.

Countries are not on track to double energy efficiency

Air conditioners

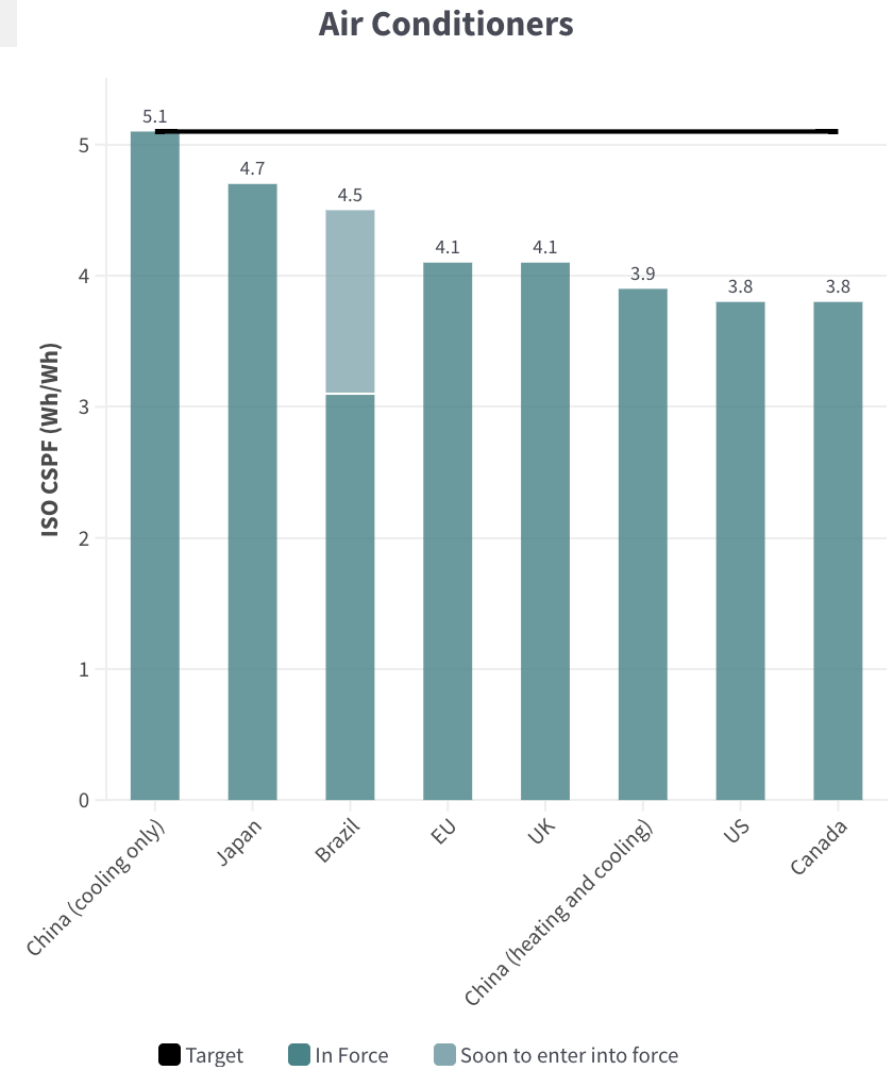


- Initial data includes 5 Call to Action signatories and 1 other country
- While some countries show improvement, no progress on average
- Metric is seasonal (SEER, CSPF, APF) or full-load (EER) efficiency (higher is better)

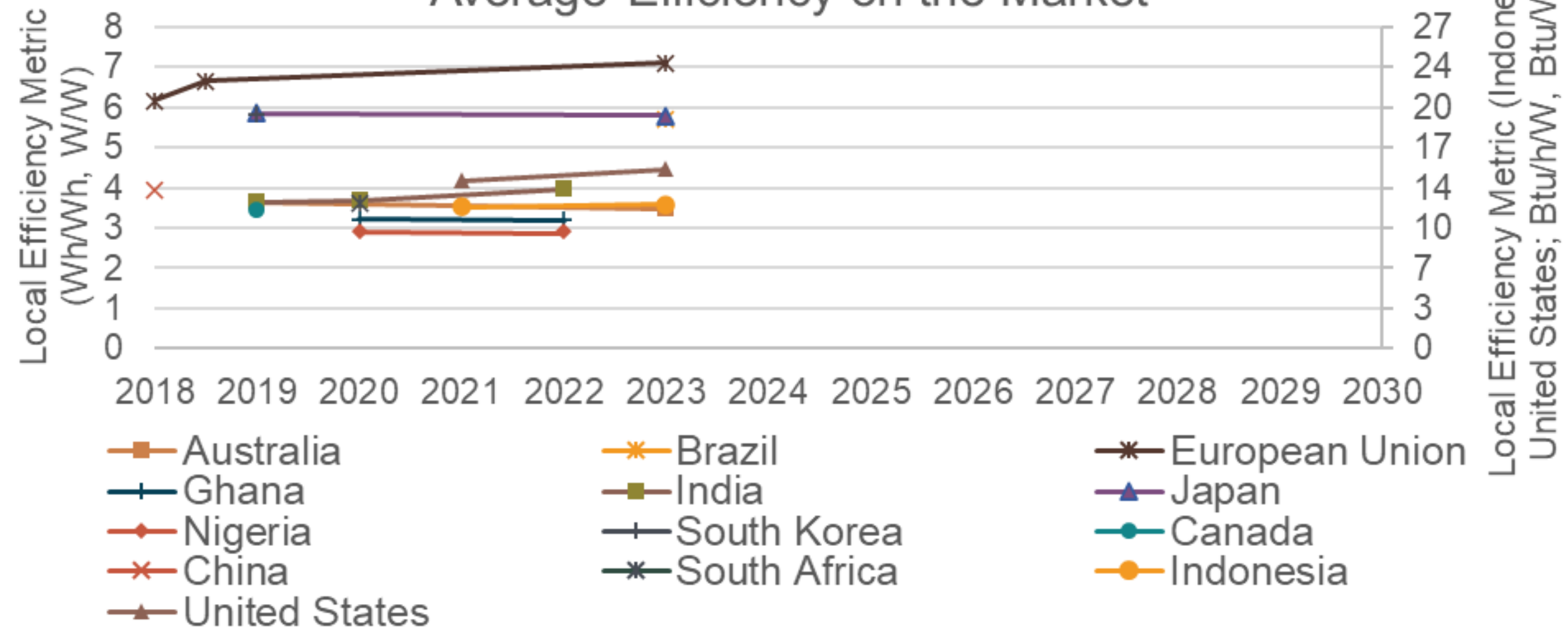
Which countries have leading appliance standards?

World's Best MEPS

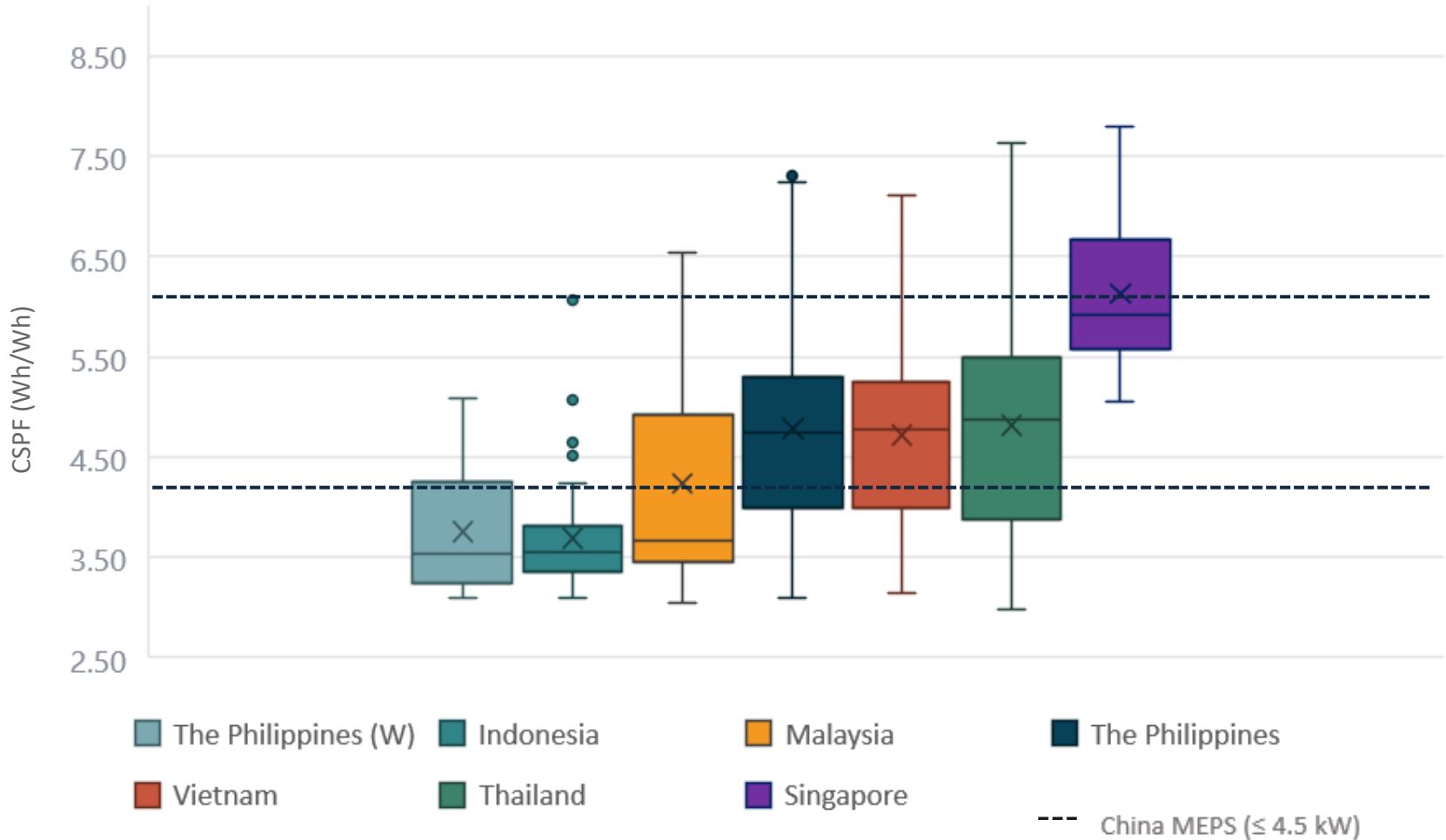
- Reviews MEPS across key countries for six high energy-consuming appliances & equipment (e.g., air conditioning, electric motors, lighting, refrigerators, space heating, and water heating).
- Compares MEPS to global goals and benchmarks



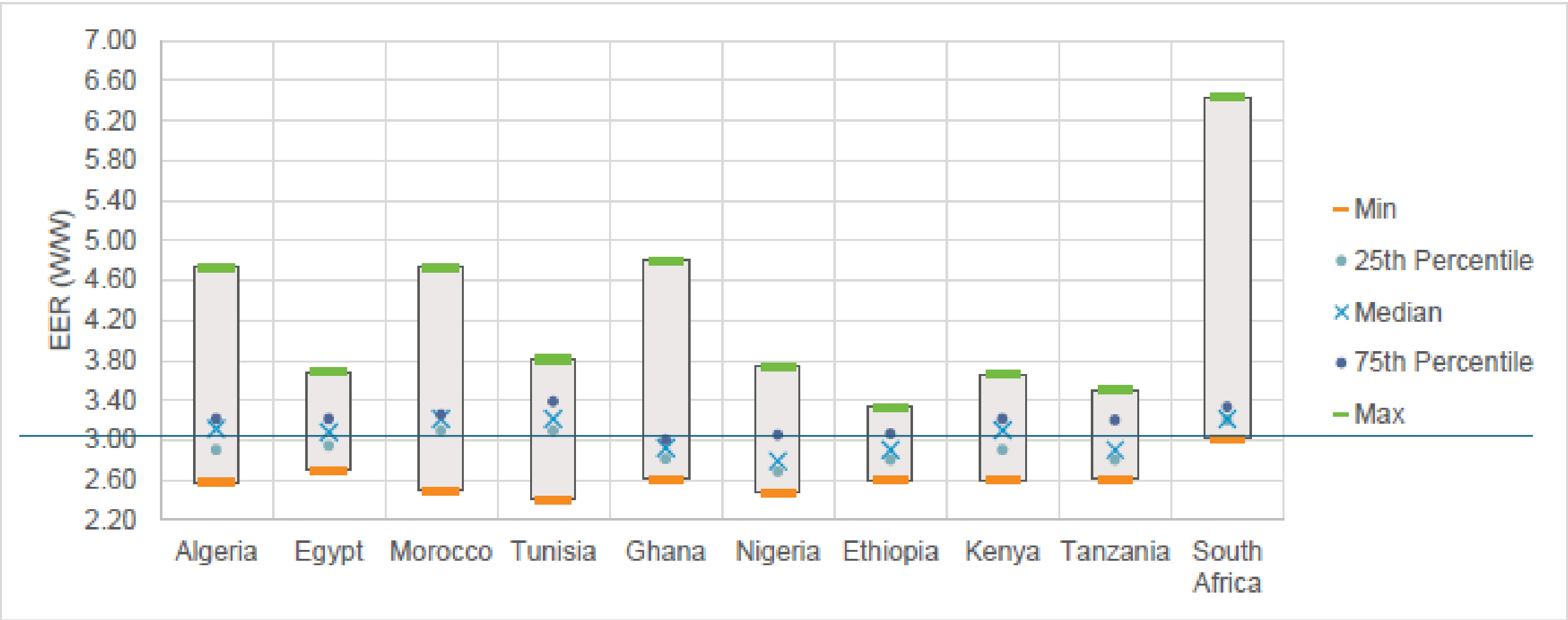
Split Air Conditioner Average Efficiency on the Market



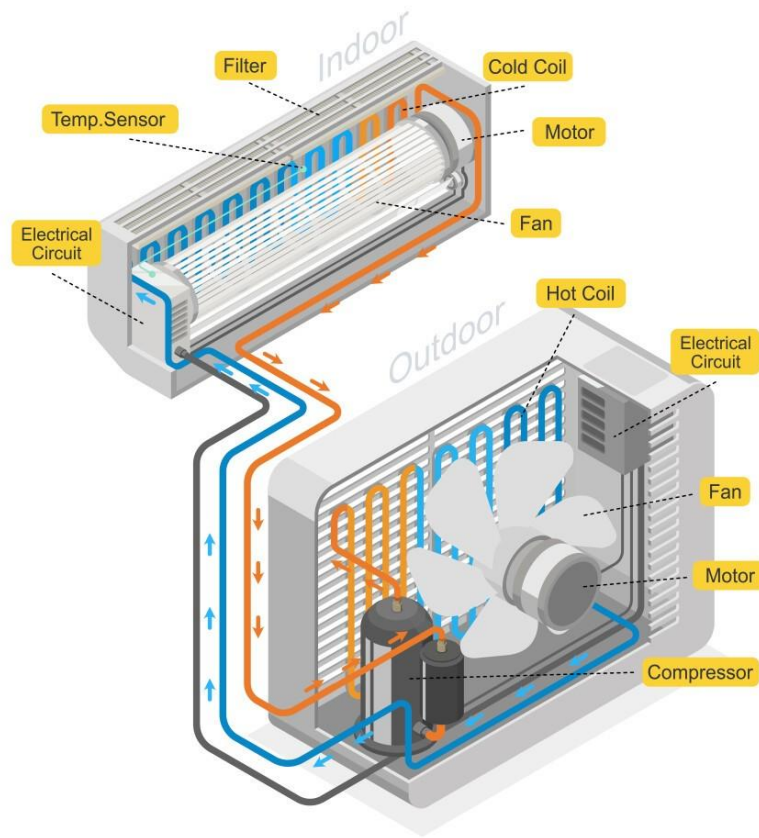
Room AC Markets in Southeast Asia, 2021



Room AC Markets in Africa, 2018



Technological pathway for double energy efficiency for RACs



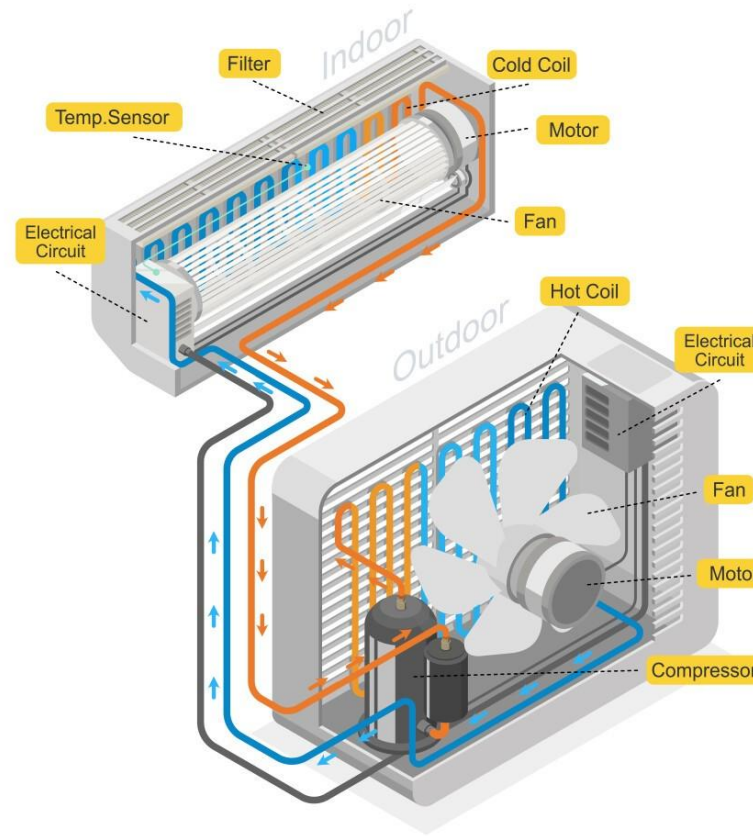
Core components of RACs for efficiency improvement:

- Compressor
- Heat exchanger
- Fan and motor
- Intelligent control algorithms

A pathway study for doubling energy efficiency for RACs

Heat Exchanger: 10% increase of size leads to **5%** EER increase. Cost may increase **25%** due to materials and complexity of manufacturing process.

Optimizing **frequency control** algorithms has the potential to improve the COP by **4% to 7%**, but it also increases manufacturing costs by **8% to 12%**.



Fan Motor:

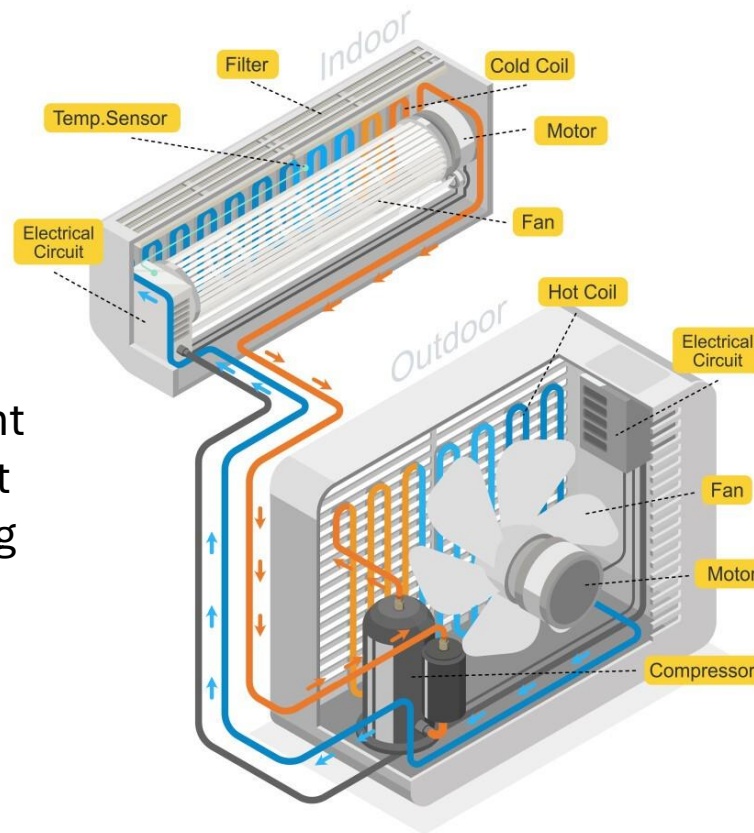
Using Permanent Magnet Synchronous Motors (PMSM) can increase motor efficiency by **10%**. Optimizing motor control algorithms can bring **5%** efficiency.

Cost:

PMSMs are **20%** more expensive than traditional motors. Optimizing motor control algorithms accounts **5%** of the total motor cost.

A pathway study for doubling energy efficiency for RACs

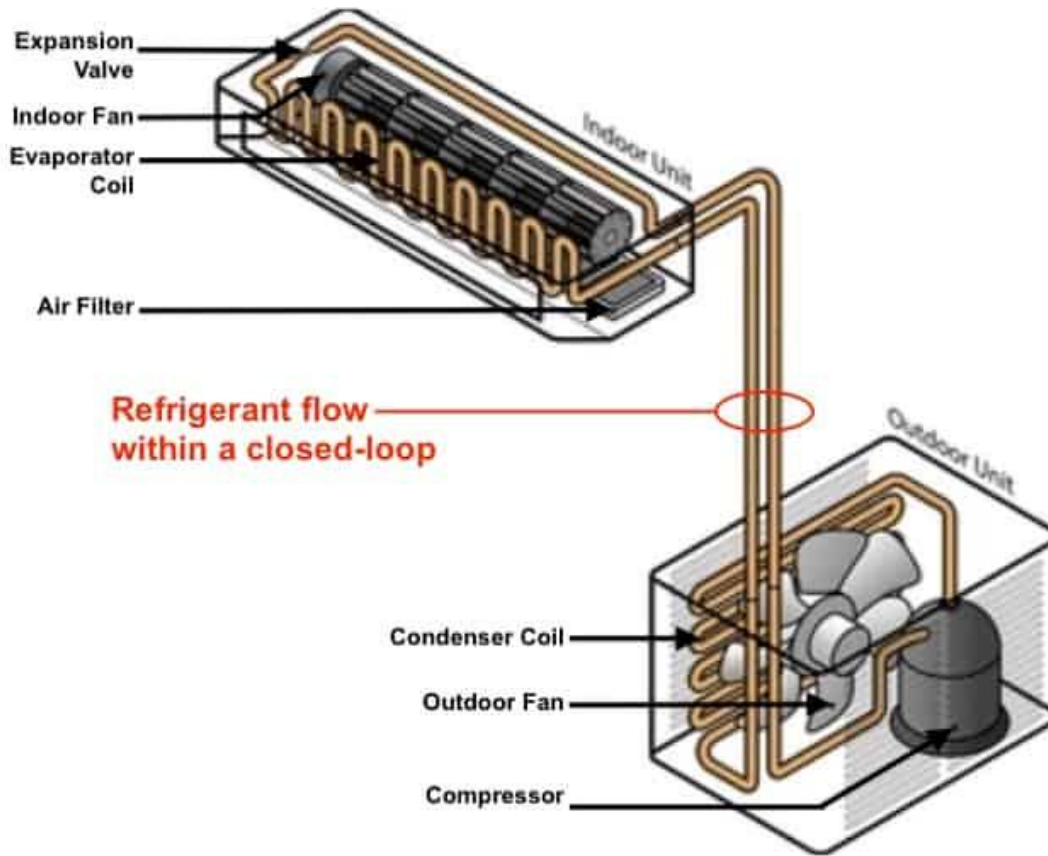
With **sensors and intelligent control systems**, RACs automatically adjust their operating modes to achieve precise energy savings. the potential for further improvement in overall energy efficiency about **8% to 13%**, with a corresponding cost of **12% to 20%**.



Compressor Efficiency Optimization: Compared to fixed-speed products, the inverter compressor has improved EER of RAC by **16%**. Two-stage compressors further enhance compression efficiency by up to **15%**.

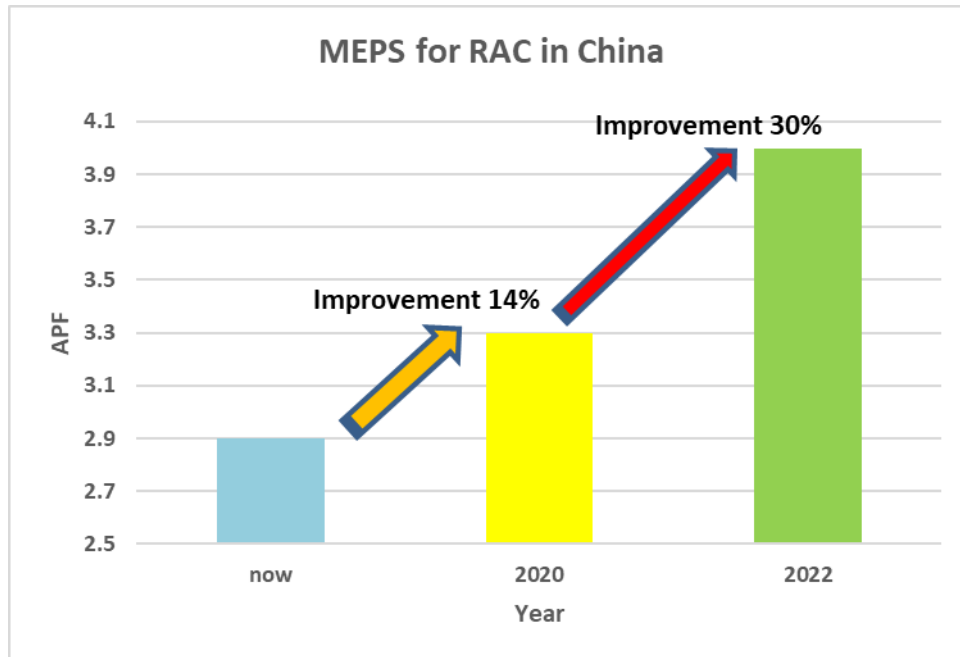
The manufacturing cost of inverter compressors is about **30%** higher than the traditional compressors. The two-stage compressors is **25%** more expensive than single-stage compressors.

A pathway study for doubling energy efficiency for RACs



Based on the latest available technologies and under the condition of a manageable overall cost increase of **10%**, the annual performance factor (APF) of RACs is expected to reach **6.25**, by China's GB 21455-2019 standard.

China's progress towards doubling energy efficiency for RACs



- New dynamic load testing method
- Electrical auxiliary heating
- Smart controls and AI
- Demand response
- Low GWP refrigerant
- Energy consumed new features: fresh air, network standby, etc.

Appliance policies are critical tools to improve efficiency



Standards: Clear the market of the most inefficient products by specifying the minimum energy and performance requirements that an appliance must meet.



Labels: Help inform consumer purchase decisions by providing information about the energy performance of a specific product.



Incentives: Help to accelerate the replacement of inefficient appliances by lowering the first cost.

Conclusions

- The World is not on track to achieve the global doubling goal.
- Net zero appliance targets are ambitious, but not out of reach.
- There is a technological pathway toward doubling efficiency, but energy efficiency improvement comes with a cost.
- There is a cost-effective way to achieve doubling efficiency.
- Countries at various energy efficiency statuses could develop tailor-made policies to improve energy efficiency.
- International cooperation is critical to accelerate global energy efficiency improvements.



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THANK YOU!