# Accelerating the Adoption of Energy-Efficient Lighting, Appliances and Equipment:

# An Introduction to Proven Technology and Policy Solutions

**Webinar**

**25 July 2017**





# Economic, Social and Environmental Benefits

Savings on Electricity bills Increases Purchasing Power

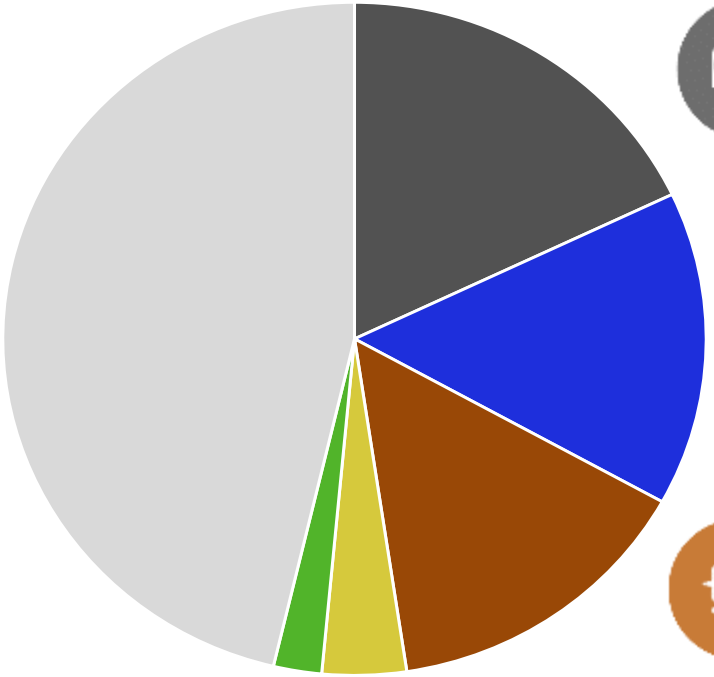
Frees Up Power Generation Capacity for Development

**The cleanest, fastest, cheapest way to fuel economic development - Energy Efficiency**


Reduces $CO_2$ Emissions and Air Pollution

Accelerates Economic Development

# Products That Use >50% of Global Electricity



**Room Air Conditioners**
- Can improve efficiency by ≥ 35%

**Indoor & Outdoor Lighting**
- Can improve efficiency 50 to 90%

**Electric Motor Systems***
- Can improve efficiency 20 to 30%

**Residential Refrigerators**
- Can improve efficiency by 30 to 60%

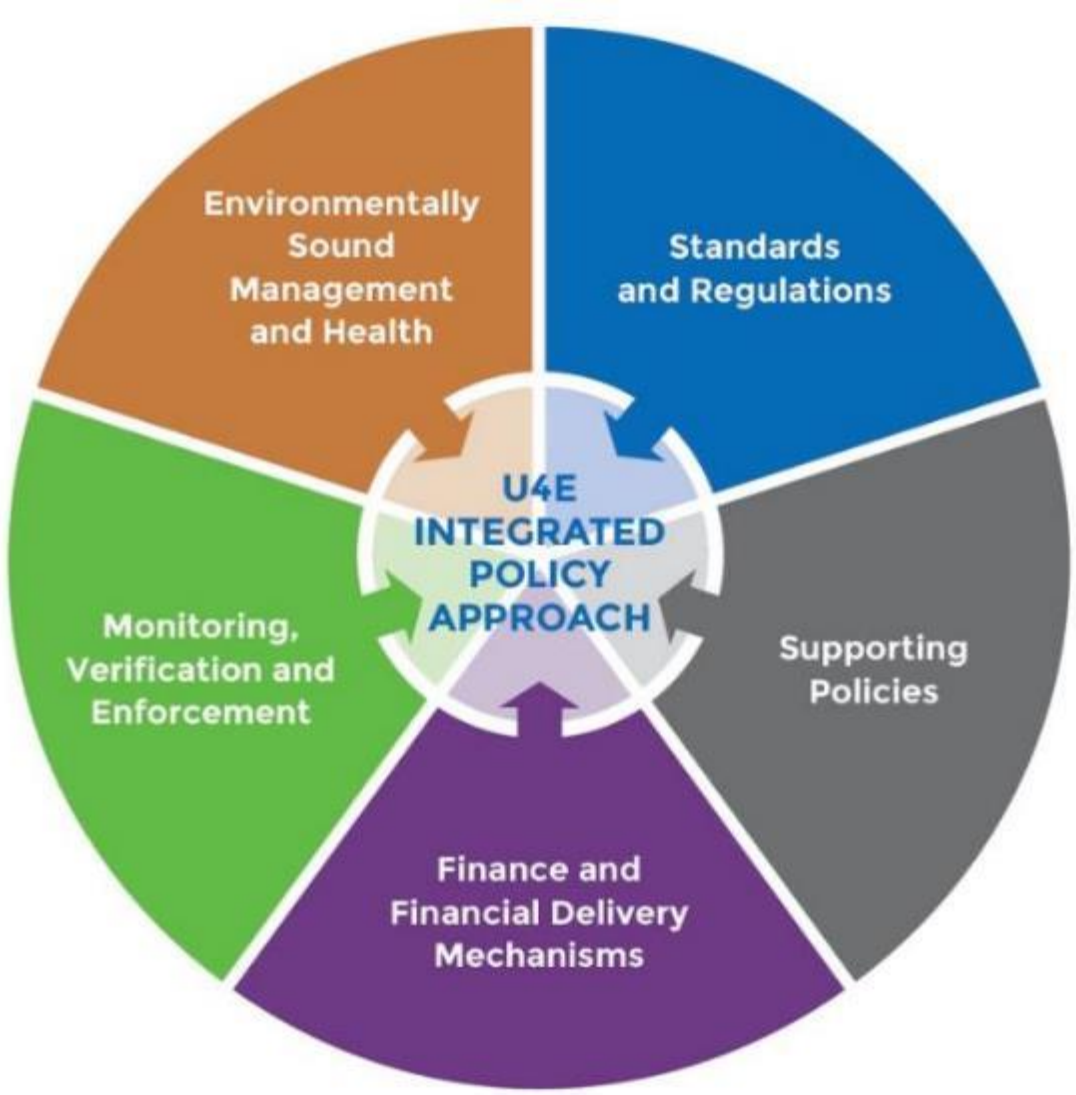
**Distribution Transformers**
- Can improve efficiency by ≥ 30%

Sources: International Energy Agency; Lawrence Berkeley National Laboratory; UN Environment

Method: Approximate savings in 2030 in emerging & developing economies if today's best available technologies are adopted

*Electric motors systems use over half of global electricity, some of which is accounted for in ACs and Refrigerators

# The Integrated Policy Approach Transforms Markets



# U4E Project Partners - Working Together

## MANUFACTURERS & INDUSTRY ASSOCIATIONS

OSRAM
PHILIPS
MEGAMAN®
mabe
International Copper Association Copper Alliance
Electrolux
B/S/H/
arçelik
Whirlpool CORPORATION
ABB

## TECHNICAL ORGANISATIONS & INITIATIVES

clasp
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NRDC
CARBON TRUST
IIEC International Institute for Energy Conservation
BASE
COPENHAGEN CENTRE ON ENERGY EFFICIENCY SE4ALL EE HUB
GLOBAL LIGHTING CHALLENGE A Clean Energy Ministerial Campaign
NIS
EESL
4E
GELC
AMBILAMP RECICLAMOS LA LUZ
GLOBAL CLIMATE PARTNERSHIP FUND
topten
AC ADVANCED COOLING CHALLENGE A Clean Energy Ministerial Campaign

## Funder & Implementing Agencies

gef
UN environment
UNDP

# Supporting Policymakers

## Level 1

**150 Country Assessments**

**6 Policy Guides**

**30 Lighting documents**

**Other tools & resources**

www.united4efficiency.org

## Level 2

**Regional Market Assessment**

**Regional Policy Roadmap**

**Regional Harmonisation**

**Regional Training for Policymaker; Practitioner**


## Level 3

**National Action Plan**

**Help develop funding proposal**

**Technical assistance with implementation**

Images Source: Google Maps

# U4E Savings Assessments for 150 Countries

## Nigeria

Energy efficiency benefits from lighting, residential refrigerators, room air conditioners, power and distribution transformers and industrial electric motors with the implementation of globally benchmarked minimum energy performance standards.

### ANNUAL SAVINGS IN 2030

Reduce electricity use
- → by over **8 TWh**
- → **11.5%** of future national electricity use

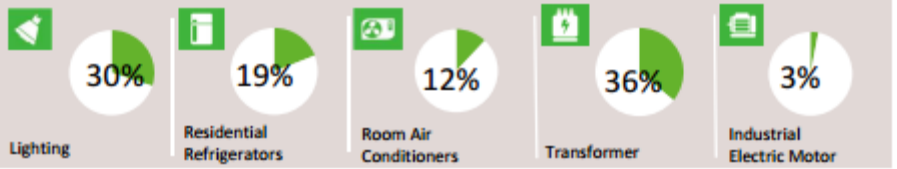
Save electricity worth **500 Million USD**

equivalent to **19 Power Plants [100MW]**

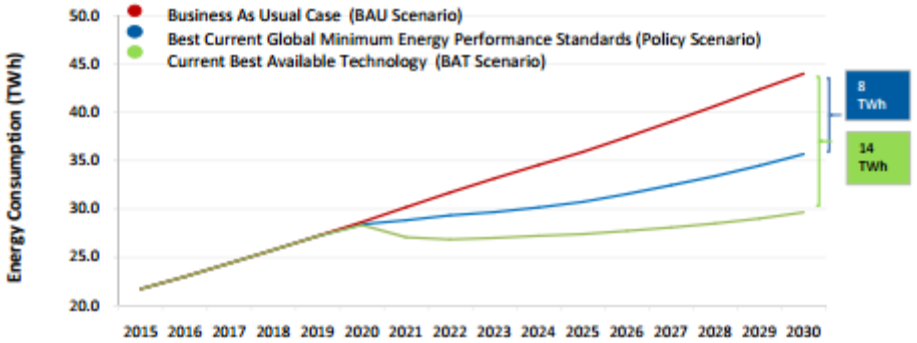
Reduce $CO_2$ emissions by **4 Million Tonnes**

equivalent to **2 Million Passenger Cars**

### SHARE OF EACH TYPE PRODUCT TO THE COUNTRY'S TOTAL SAVINGS IN 2030




### EVEN GREATER SAVINGS POSSIBLE WITH BEST AVAILABLE TECHNOLOGY




## Brazil

Energy efficiency benefits from lighting, residential refrigerators, room air conditioners, power and distribution transformers and industrial electric motors with the implementation of globally benchmarked minimum energy performance standards.

ANNUAL SAVINGS IN 2030

Reduce electricity use
- → by over 69 TWh
- → 8.1% of future

Save electricity worth

equivalent to 32 P

Reduce $CO_2$ emissi

equivalent to 3

SHARE OF EACH TYPE PRODUC

11%

Lighting

EVEN GREATER SAVIN

## Indonesia

Energy efficiency benefits from lighting, residential refrigerators, room air conditioners, power and distribution transformers and industrial electric motors with the implementation of globally benchmarked minimum energy performance standards.

ANNUAL SAVINGS IN 2030

Reduce electricity use
- → by over 36 TWh
- → 10.6% of future national electricity use

Save electricity worth 4 Billion USD

equivalent to 16 Power Plants [500MW]

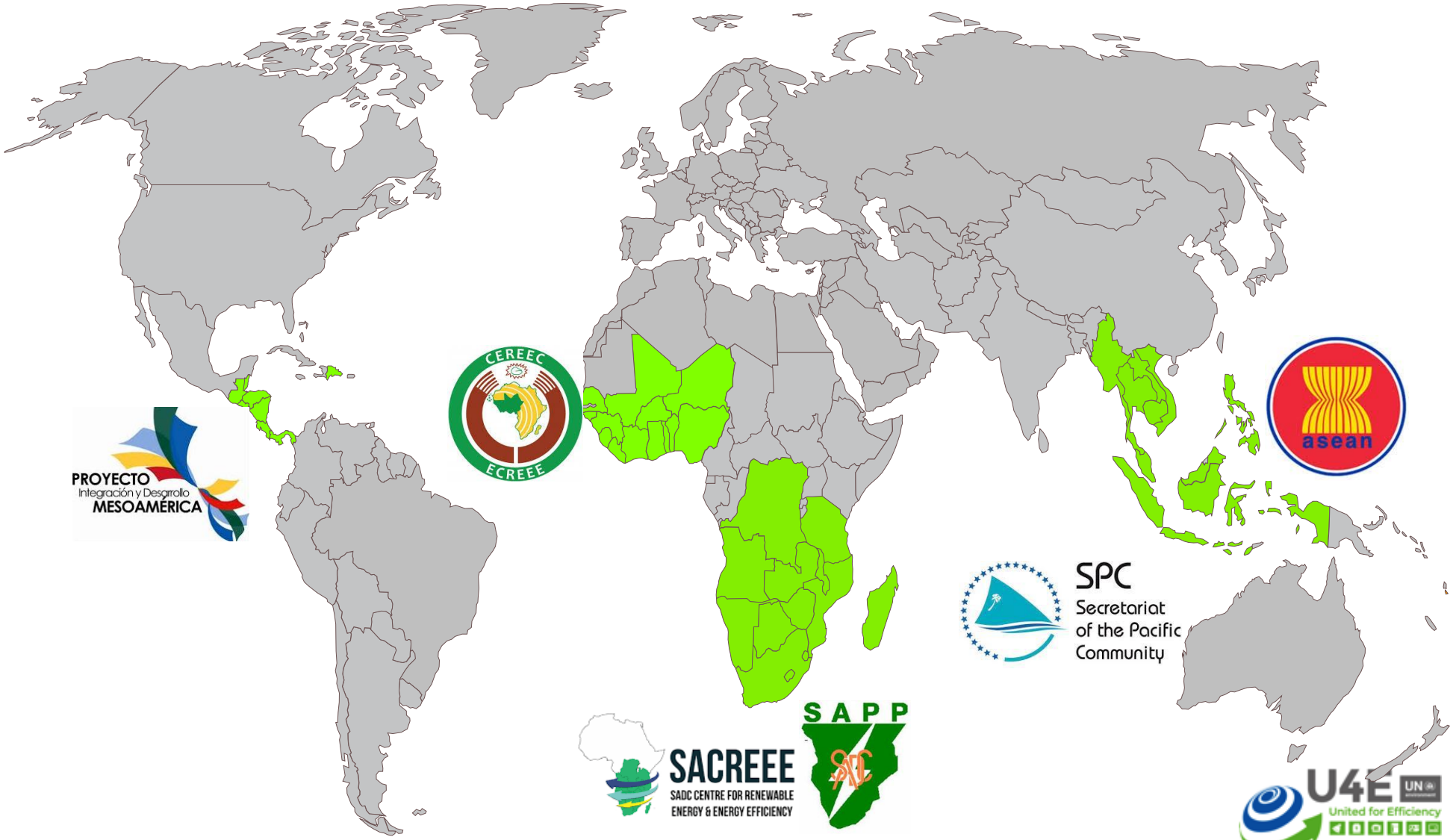
Reduce $CO_2$ emissions by 30 Million Tonnes

equivalent to 20 Million Passenger Cars

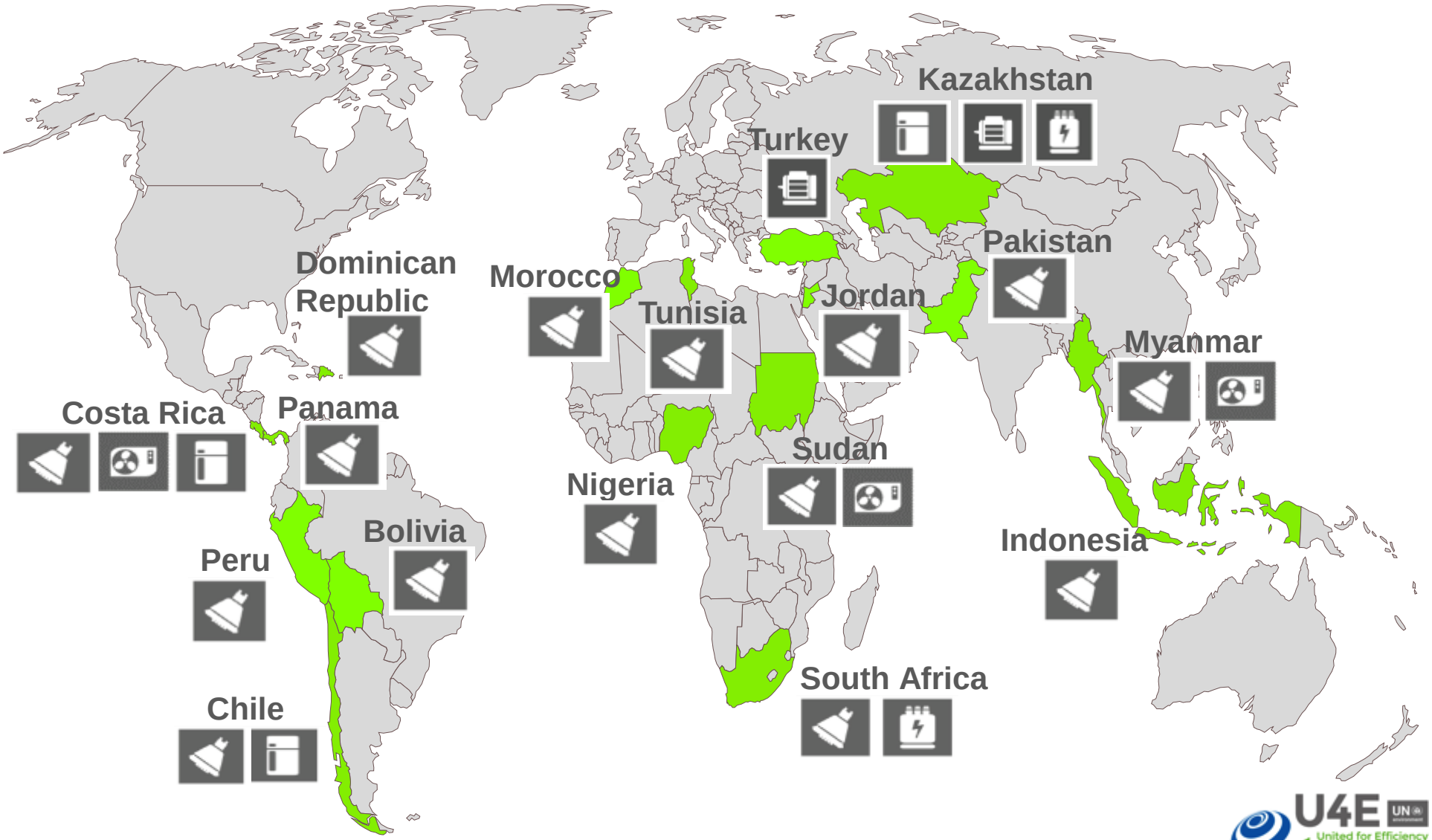
SHARE OF EACH TYPE PRODUCT TO THE COUNTRY'S TOTAL SAVINGS IN 2030


EVEN GREATER SAVINGS POSSIBLE WITH BEST AVAILABLE TECHNOLOGY

# U4E Regional Collaboration



# U4E National Projects



# Find Out More

**Save the Date: U4E Event at COP23 in Bonn - November 15, 2017**

- Review progress on efficient lighting, appliances and equipment around the world
- Announce new opportunities and key developments
- Network with senior officials, top business executives and civil society leaders
- Free to attend, registration opening soon (space is limited)
- Notify U4E@unenvironment.org to be added to email list for future updates

**U4E Website**: www.united4efficiency.org

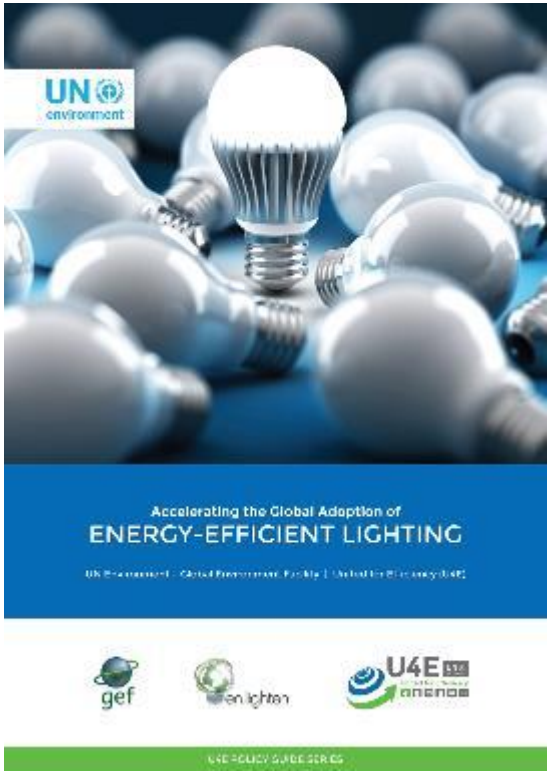
**YouTube**: https://youtu.be/R_CyITZ6HFk

# Energy-Efficient Lighting Policy Guide

# Indoor and Outdoor Lighting

## Background

- Inefficient, short-lived products are still common
- Rapid evolution in technology and prices in past 15 years
- Energy and environmental impact
  - Consume **15%** of global electricity
  - Quality products can cut power use up to 90%
- Great product for governments to start with when transforming their markets with efficient products



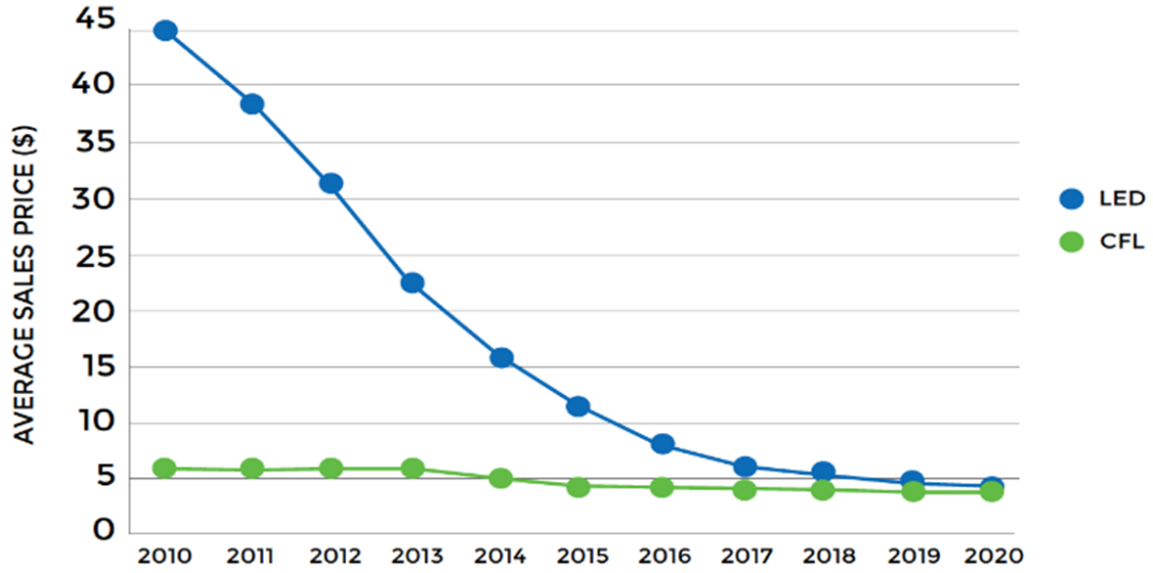

# Scope of the Policy Guide



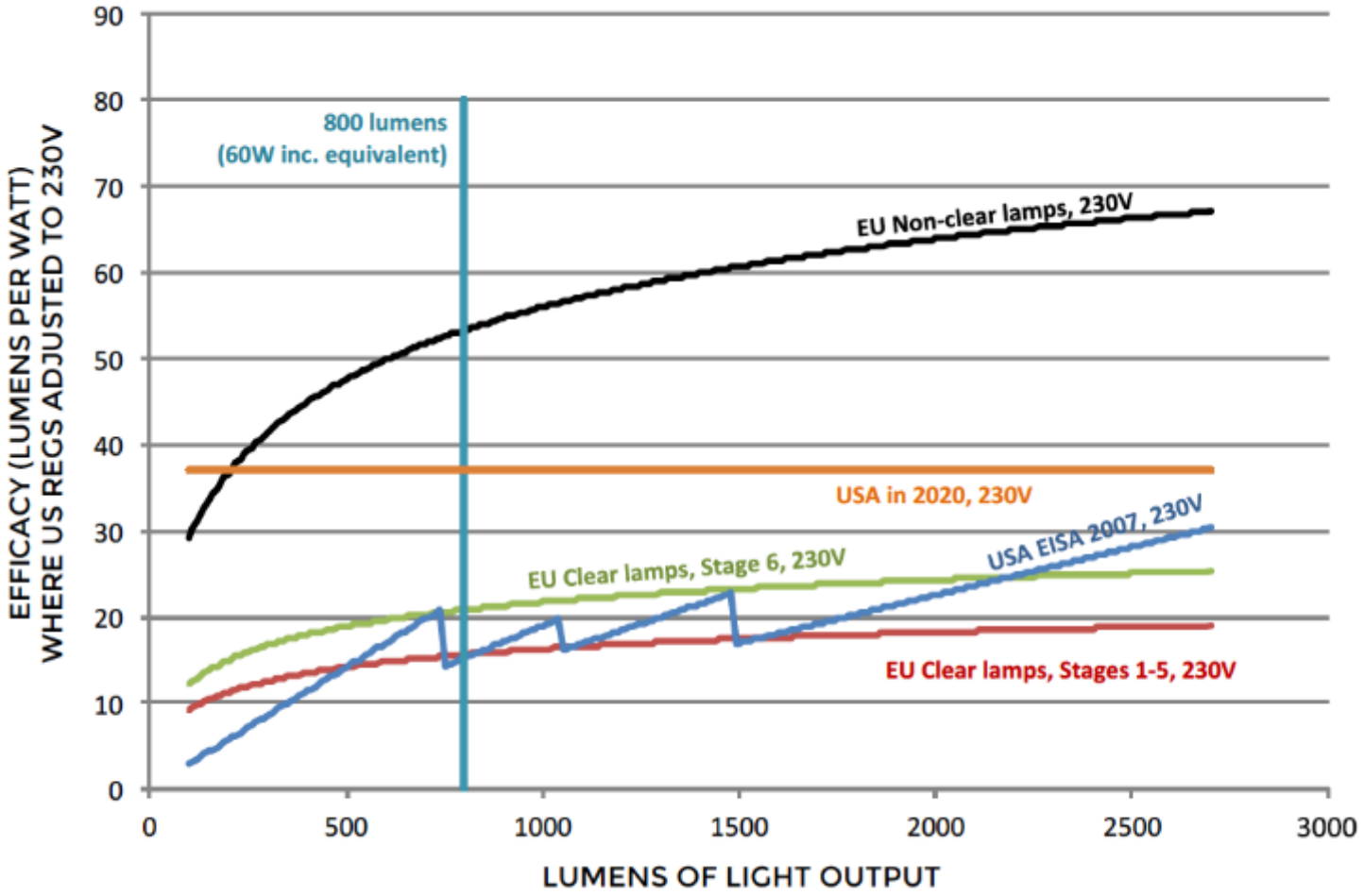

| | Incandescent and Halogen | Fluorescent: CFL and LFL | High Intensity Discharge: MV, HPS, MH | LED lamp and luminaire |
|---|---|---|---|---|
| Efficacy | 8 - 21 lm/watt | 50 - 110 lm/watt | 45 - 100 lm/watt | 60 - 150 lm/watt |
| Lifetime | 1,000 - 3,000 hrs | 6,000 - 30,000 hrs | 10,000 - 24,000 hrs | 15,000 – 60,000 hrs |
| Colour Temp. | 2,600 - 3,200 K | 2,500 - 6,500 K | 2,000 – 5,700 K | 2,700 – 6,500 K |
| Colour Rendering | 100 | 70 - 95 | 15 - 85 | 70 - 95 |
| Dimmable | Yes | If dimmable ballast | If dimmable ballast | If dimmable driver |

# Why Leapfrog to Energy-Efficient Lighting

- The amount of lighting used globally is projected to rise by **50 per cent** compared to today
- A transition to energy-efficient lighting will save countries **40 – 60 per cent** in 2030
- LED lighting offer many benefits to CFL such as  better quality such as turning instantly to full brightness, content not mercury and are not as fragile
- Prices of energy-efficient LEDs have greatly DROPPED in recent years



# Comparison of Efficiency Requirements in Europe and US




For reference: the US 2020 standard will be 45 lumens per watt at US voltage (110-130V). The graph reflects the conversion to high voltage (230V).

# Sample Recommendations for Policymakers

## Standards

✓ Adopt internationally-recognized test standards

## Supporting Policies

✓ Ensure information on light output, efficacy, color rendering, color temperature, mercury content, and dimmability are on the label

## Monitoring, Verification and Enforcement

✓ Include legal authority, enforcement powers and penalties in the national legal framework

✓ Use a product registration system as an initial compliance gateway

## Financial Mechanisms

✓ Consider a blend of financing mechanisms to help offset the incremental cost of energy-efficient lighting

## Environmentally Sound Management and Health

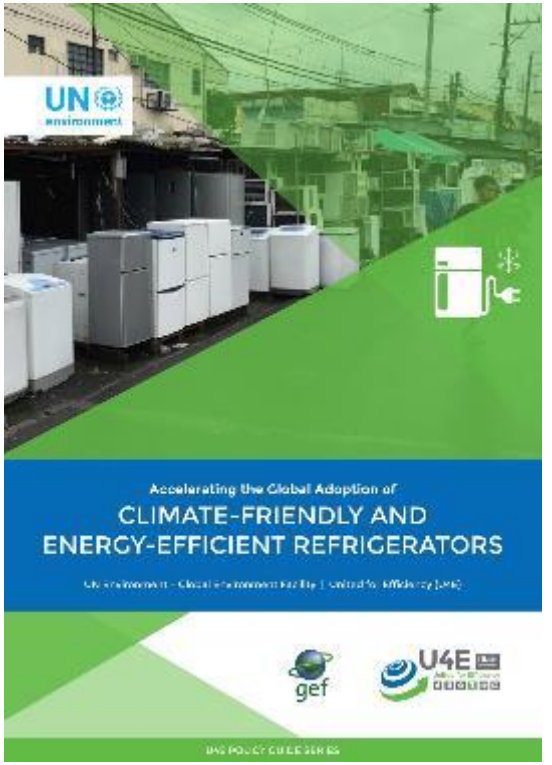
✓ Recover materials in mercury added lamps (e.g. glass, ferrous and nonferrous metals and phosphors)

# Climate-Friendly and Energy-Efficient Refrigerators Policy Guide

# Household Refrigerators

## Background

- Most popular household appliance (typically refrigerator-freezer model)
- Stock in developing / emerging economies doubles to almost **2 billion by 2030**
- Energy and environmental impact
  - 10% of household energy consumption
  - Outdated units use 3X more electricity (>700 kWh/year) vs. best ones (< 250 kWh / year)
  - Some refrigerants have GWP well over 1000X more potent than CO2
  - Some refrigerants damage the ozone layer



# Scope of the Policy Guide

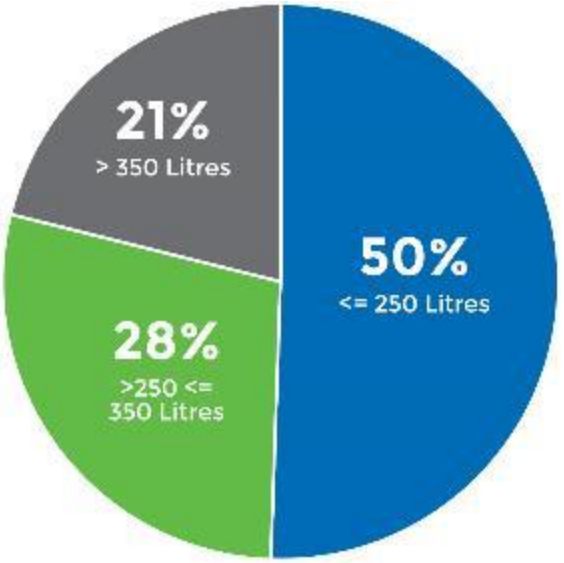
## Household Refrigeration

**REFRIGERATORS**
(one or more chilled compartments, generally at various temperature zones between 0°C and 14°C, and which may include an ice-making section)

**FREEZERS**
(one or more frozen compartments, usually between -18°C and -6°C)

**FRIDGE-FREEZERS**
(combination of both chilled and frozen compartment(s) in the same appliance)

### Global Sales by Volume




Source: GfK 2008

# Refrigerator Improvements

## 1 INSULATION

**The most important energy-saving technology is improved insulation.** 60 per cent of the heat leakage into a refrigerator comes in through the walls and door[7]

**700 kWh**
**PRE REGULATION**

## 2 COMPRESSORS

**Compressors with much improved efficiency** compared with those of ten years ago are available globally, with little cost impact

**350 - 450 kWh**
**SUITABLE MEPS**

## 3 CONTROLS

**Improved controls,** especially for appliances with two or more compartments and for variable speed drive (invertor) controls for compressors

**250 kWh**
**STRINGENT MEPS**

# Why Leapfrog to energy-efficient and climate-friendly refrigerators?

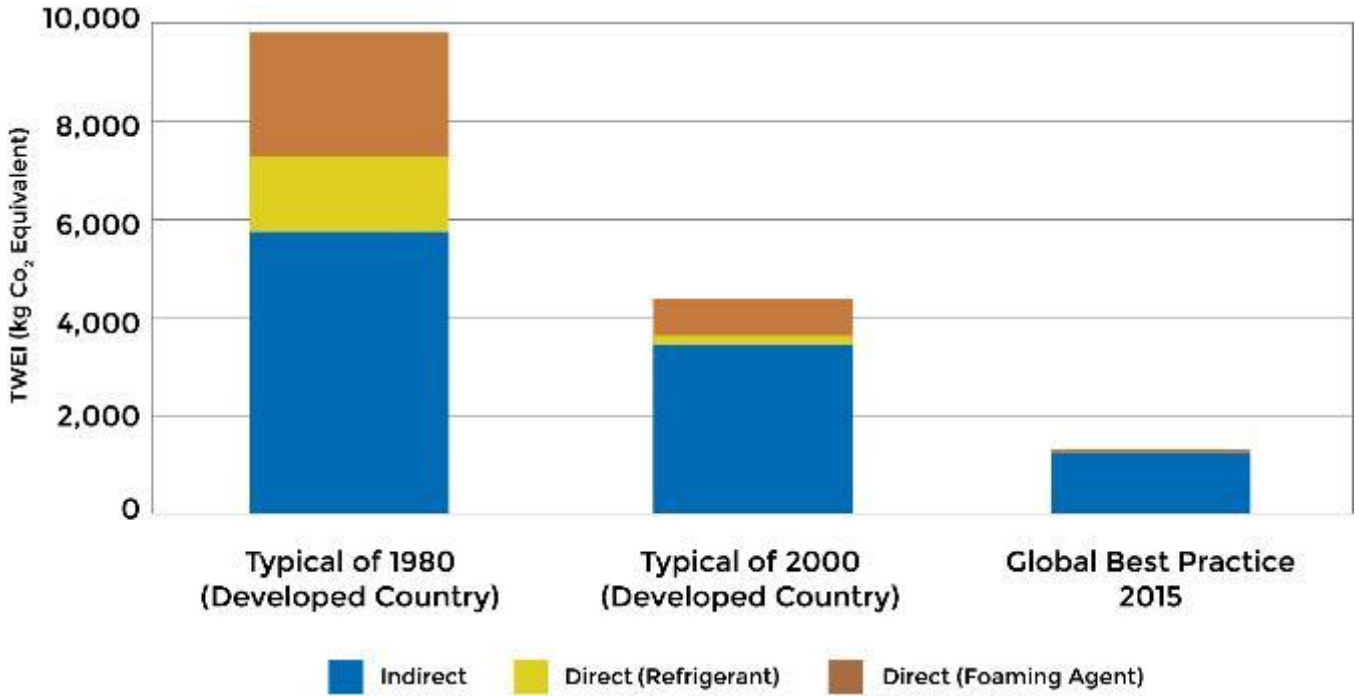
## Aggregate impacts in 150 developing countries and emerging economies in 2030:

**Annual Energy Savings (electricy consumption):** around 150 TWh = annual amount of electricy consumed by Thailand in 2012

**Lower Emissions:** around 90 million tonnes of carbon dioxide ($CO_2$) emissions annually = 20,000 round trips from Nairobi to New York

**Financial Savings:** $14 billion = Google's profits in 2015.

**Emissions Reductions:**



# Sample Recommendations for Policymakers

## Standards

- ✓ Adopt MEPS with relevant test method IEC 62552
- ✓ Ensure the refrigerant and foam-blowing agent have zero ozone depletion potential and global warming potential that is as low as practicable (GWP of 20 or less)

## Supporting Policies

- ✓ Adopt labeling requirements to convey financial, energy and climate impacts

## Monitoring, Verification and Enforcement

- ✓ Ensure compliance with energy, refrigerant and foam blowing agent requirements

## Financial Mechanisms

- ✓ Consider a blend of financing mechanisms to help offset the initial incremental cost (higher purchase price) of energy-efficient and climate-friendly refrigerators

## Environmentally Sound Management and Health

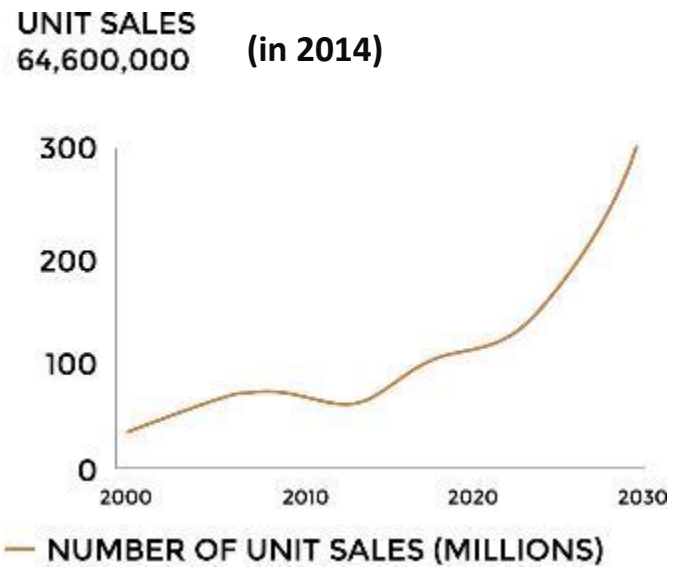
- ✓ Develop a legal framework for sound end-of-life disposal and recycling
- ✓ Ensure compliance with ISO 5149

# Climate-Friendly and Energy-Efficient Air Conditioners Policy Guide

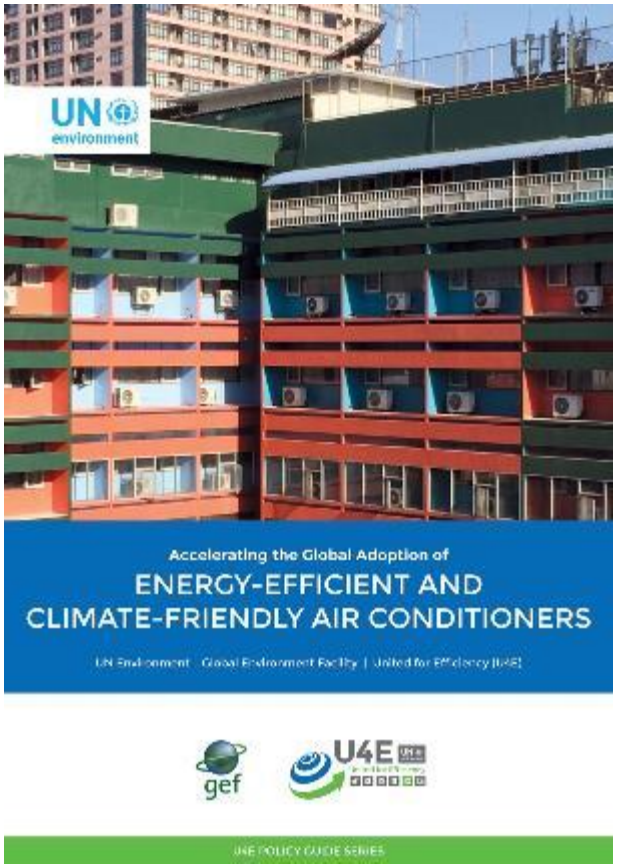
# Room Air Conditioners Policy Guide

## Background

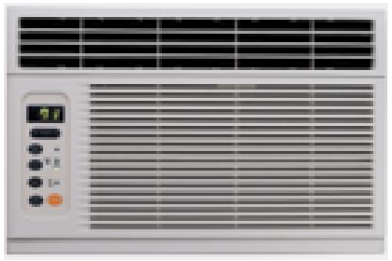
- Global stock increasing from 660 million units in 2015 to **1.5+ billion by 2030**
- Huge impact on energy and the environment
  - ➢ 20% of household energy use in warm climates
  - ➢ Global-warming potential of many refrigerants is over 1000X more potent than $CO_2$
  - ➢ Some old refrigerants damage the ozone layer




Source: Green Cooling Initiative, 2016



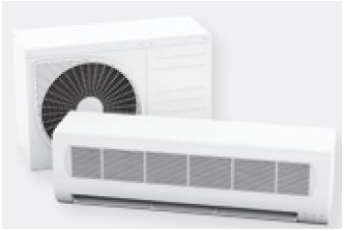
# Scope of the Policy Guide



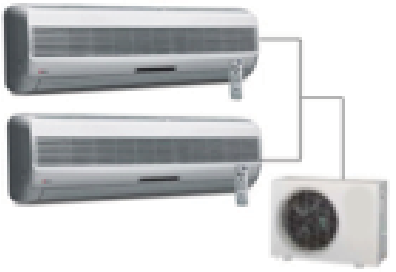
Window

Portable

Inverter Split



Non-Inverter Split



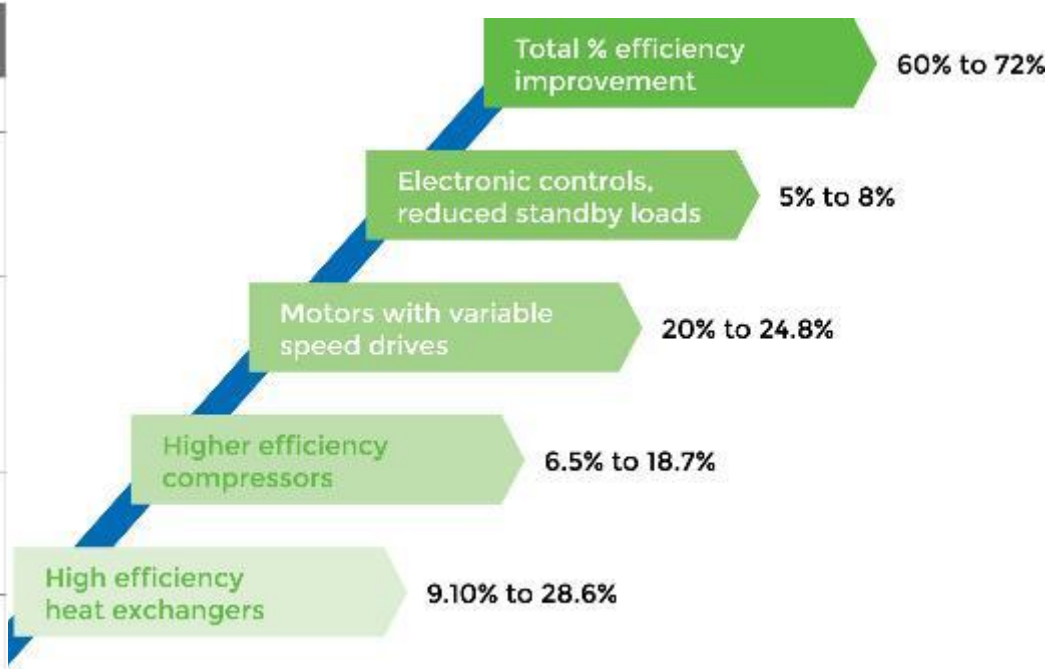
Multi-Split

# Save Energy and Reduce Emissions

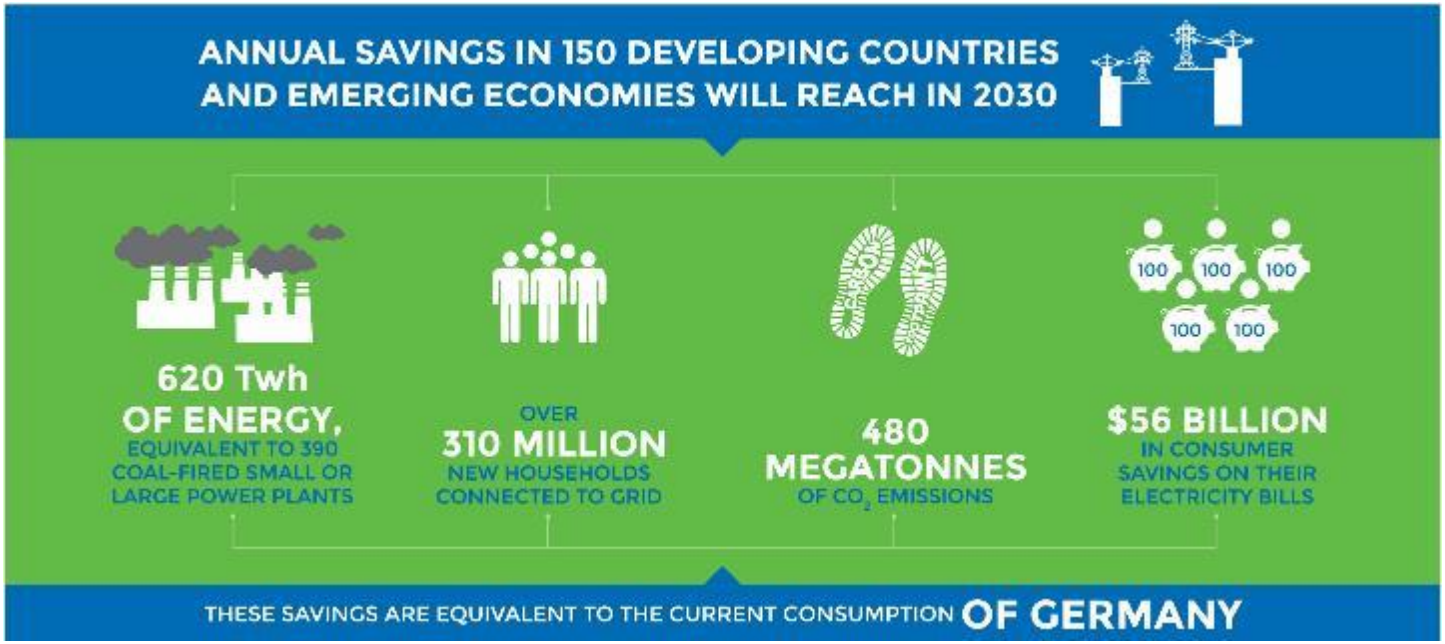
## Sample National Standards to Transform Markets

| ECONOMY | NATIONAL TESTING STANDARD | REFERENCE TEST STANDARD | METRIC USED |
|---|---|---|---|
| AUSTRALIA | AS/NZS: 3823-2013 | ISO 5151 | AEER* |
| CHINA | Fixed speed: GB/T 7725-2004<br>Variable speed: GB/T 7725-2004, GBT 17758-2010 | ISO 5151 | EER for fixed speed<br>SEER** for variable speed |
| EU | EN 14825 | ISO 5151 | EU SEER |
| INDIA | Fixed speed: IS 1391-1992 with all amendments<br>Variable speed: 16358-1:2013 | ISO 5151 | EER*** for fixed speed<br>Indian SEER for variable speed |
| JAPAN | JIS B 8616:2015 for commercial ACs<br>JIS C 9612: 2013 for Room ACs | ISO 5151, ISO 16358***** | APF**** |
| REPUBLIC OF KOREA | KS C 9306:2011 | ISO 5151, ISO 16358****** | CSPF |
| US | 10 CFR 430, Subpart B, Appendix F | Consistent with ASHRAE Standard 16/69 | US SEER |
| VIET NAM | TCVN 7830:2015 | ISO 5151, ISO 16358******* | CSPF |

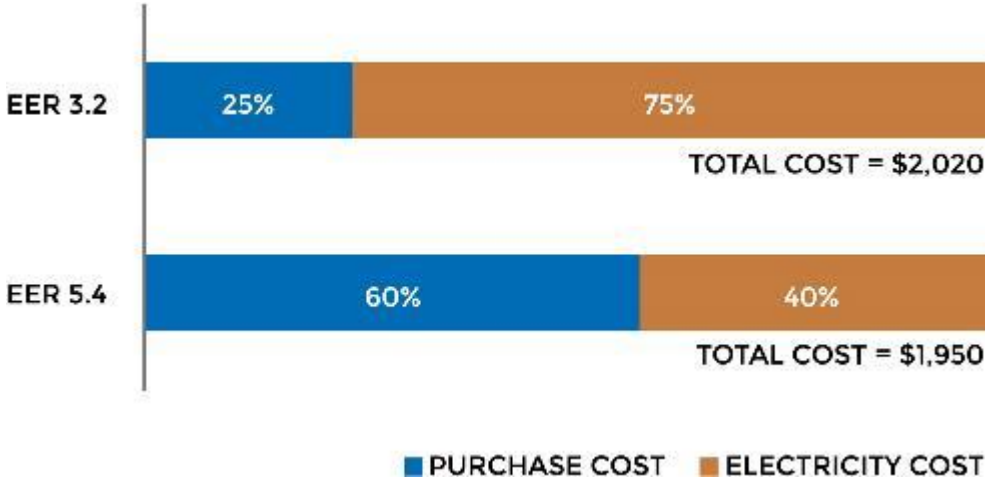
## Technology Solutions to Improve Performance



# Why Leapfrog to energy-efficient, climate-friendly AC?




## Financial Savings: Life-Cycle Cost of 1.5 tonne split system AC in India



# Sample Recommendations for Policymakers

## Standards

- ✓ EER is a starting point if no metric has been in use, but SEER is preferable.
- ✓ Ensure that the refrigerant has zero ozone depletion potential and global warming potential that is as low as practicable.

## Supporting Policies

- ✓ Include information on EER or SEER rating, and the refrigerant.

## Monitoring, Verification and Enforcement

- ✓ Use a product registration system as an initial compliance gateway.
- ✓ Adopt ISO 16358 for testing cooling capacity and performance.

## Financial Mechanisms

- ✓ Consider a blend of financing mechanisms to help offset the initial incremental cost (higher purchase price) of energy-efficient and climate-friendly air conditioners

## Environmentally Sound Management and Health

- ✓ Collect and process the steel, copper, aluminum, plastics and the refrigerant.
- ✓ Ensure compliance with ISO 5149 and IEC 60335-2-40

# Energy-Efficient Electric Motors and Motor Systems Policy Guide

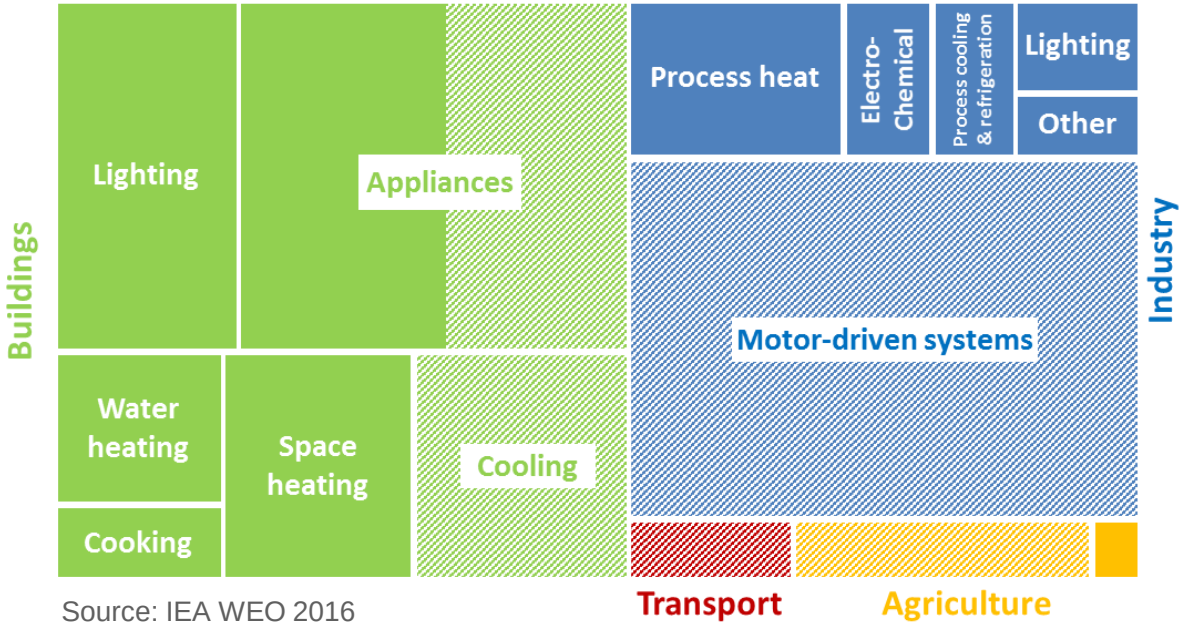
# Electric Motors and Motor Systems

## Background

- Motors are everywhere, keeping modern life in motion
  - People - Materials - Liquids - Gasses



- Huge impact on energy and environment
  - Population & economic growth drive demand
  - 20-30% energy efficiency improvements possible




Source: IEA WEO 2016

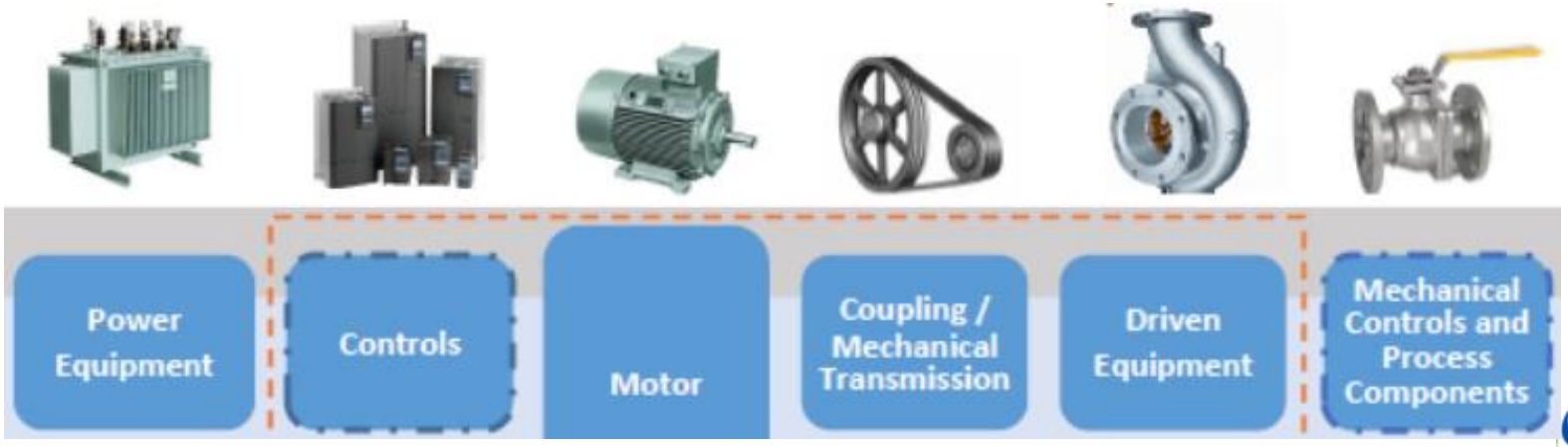
**Motors' share of global electricity use = 53%**

# Focus of the Policy Guide

- **General purpose Induction Motors**
  - 3-phase AC
  - ≤1000 Volts at 50 Hz or 60 Hz
  - 2, 4 or 6 poles
  - Output 0.75 kW – 375 kW
  - Continuous operation

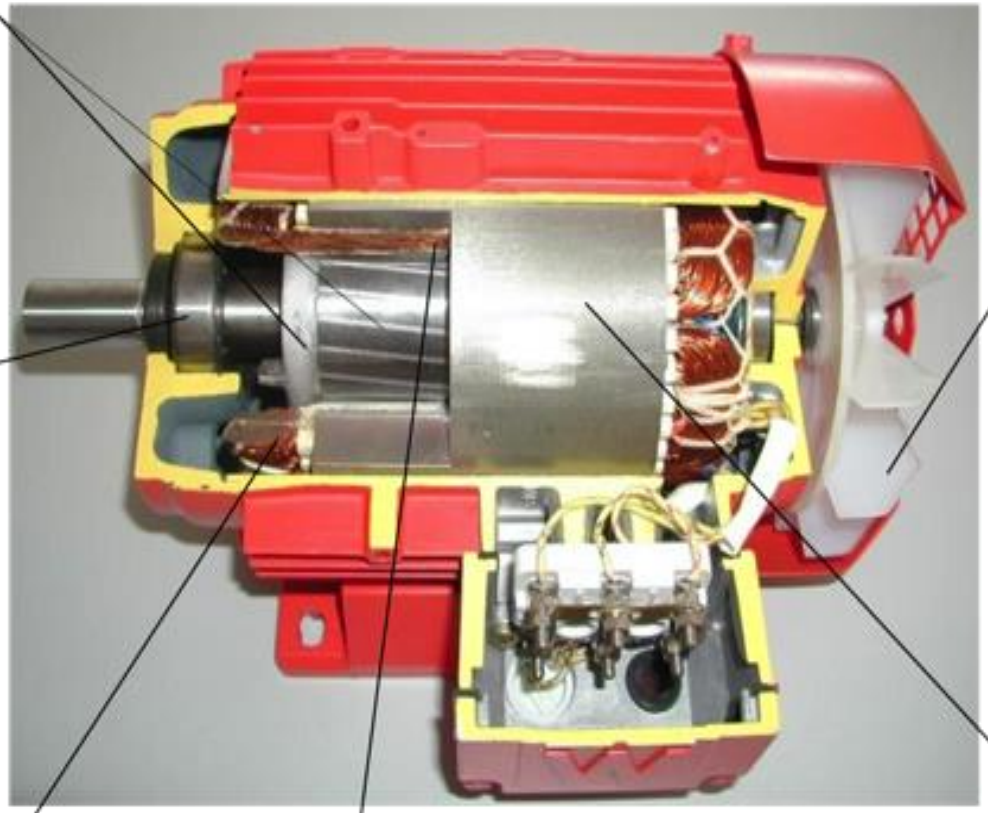
10% of motor stock /
68% of energy use by motors

- **Systems driven by these motors**



# Motor Improvements

Larger conductive bars and end-rings or conductors of lower resistivity (Copper instead of Aluminium) reduce rotor resistance



Efficient cooling fan design improves air-flow and reduces power required to drive the fan

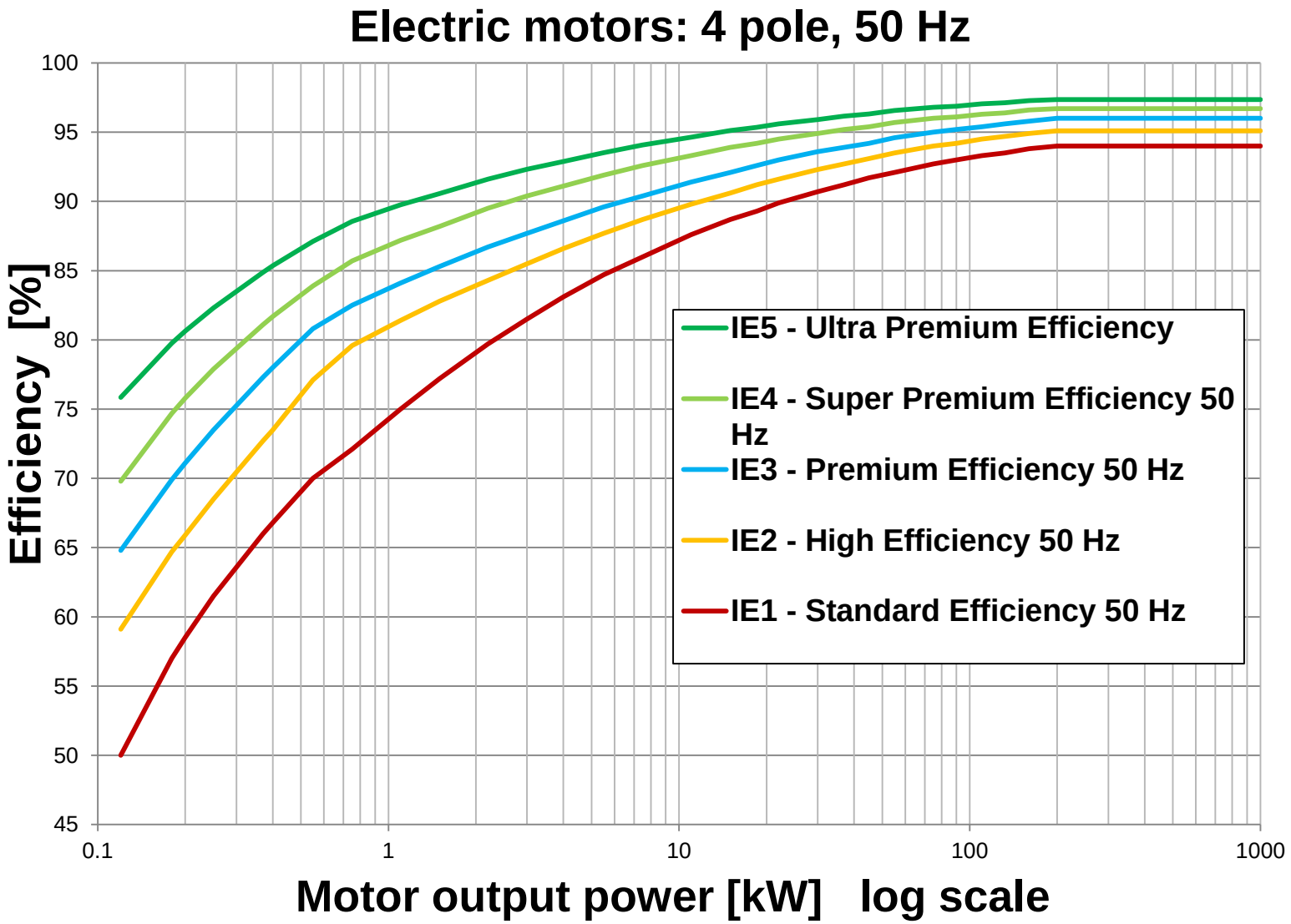
Reduced friction bearings

Longer stator lowers magnetic density and increases cooling capacity. Premium grade magnetic steel reduces hysteresis losses; thinner laminations reduce eddy current losses.

More copper wire of larger diameter in the stator saves energy by reducing the resistance of the stator winding

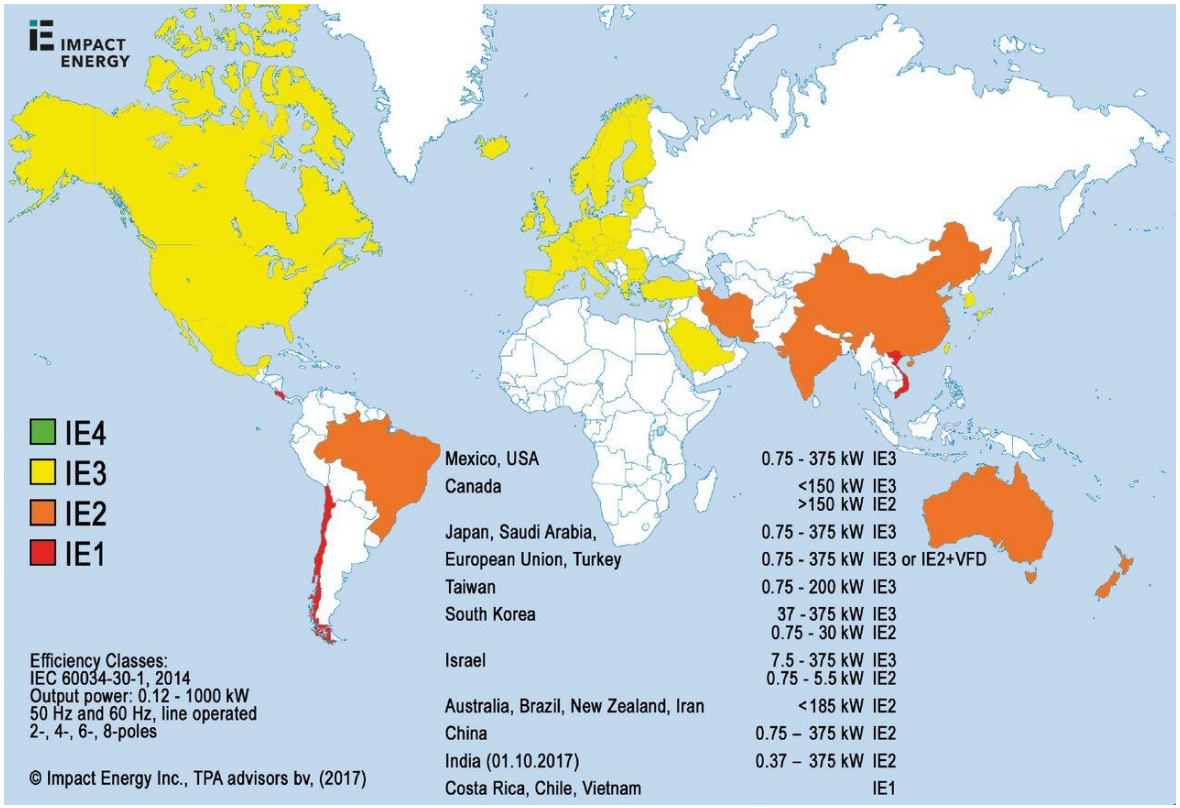
Modified stator slot design helps to decrease magnetic losses and makes room for larger diameter wire

# IEC Efficiency Classes for Motors

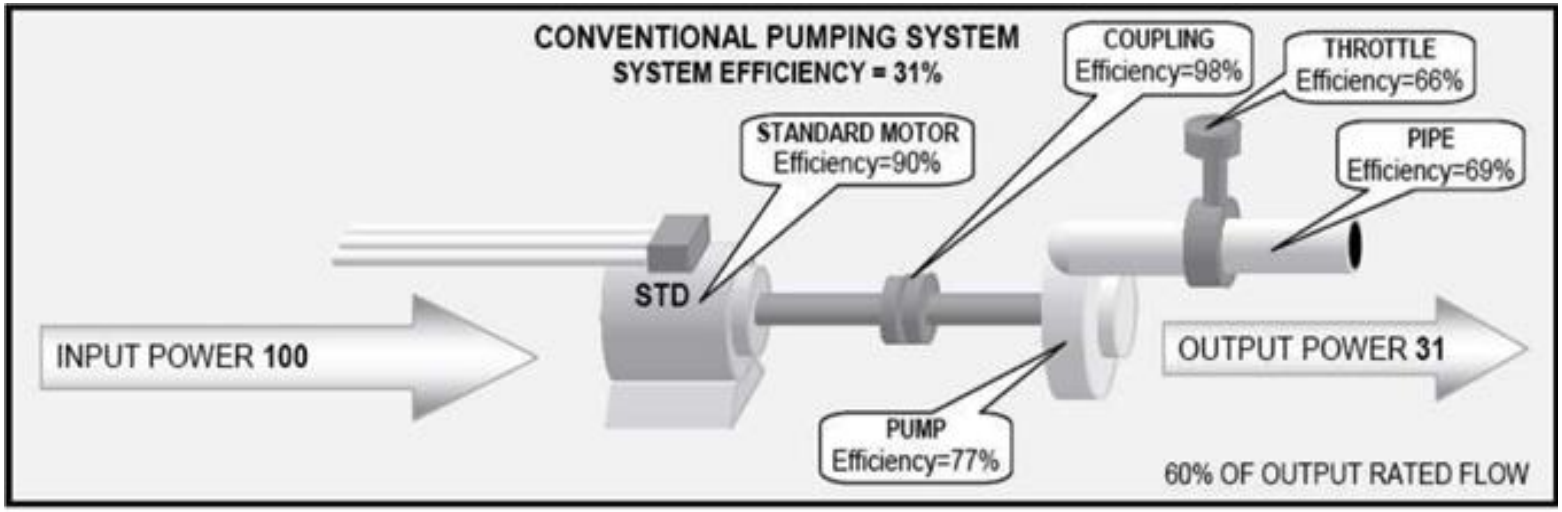


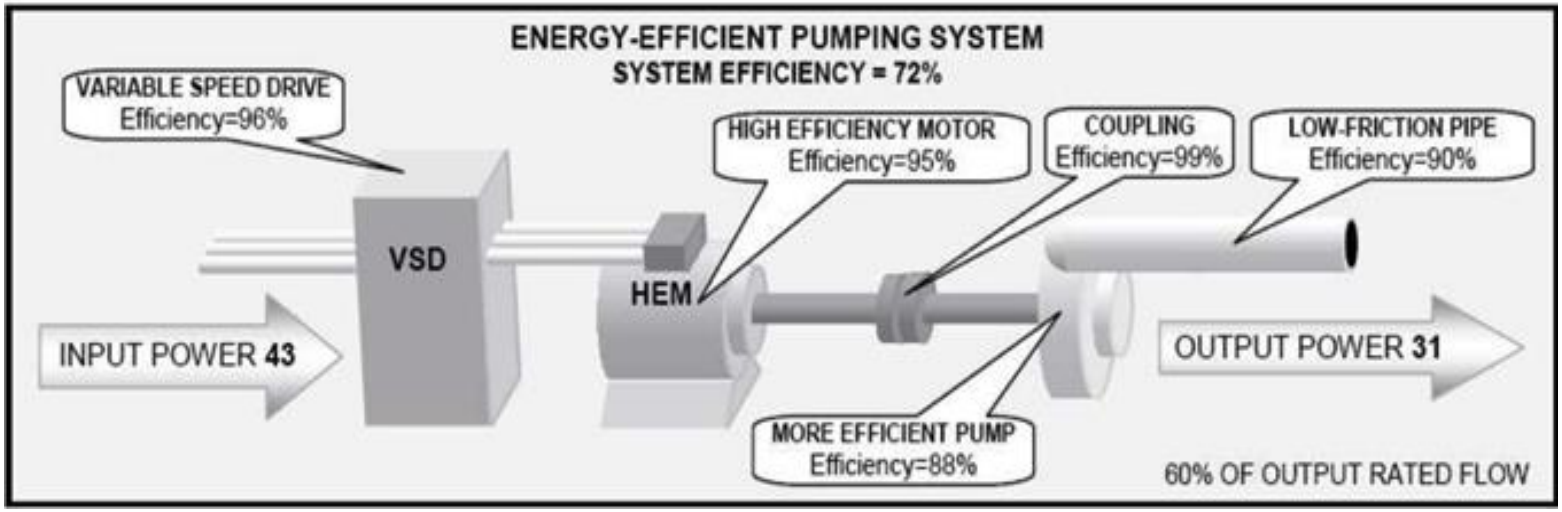
# Why Leapfrog to Energy-Efficient Motors?

- 41 countries (81% of global electricity use in motor systems) have steered their markets toward higher efficiency motors
- Significant risks of inaction
  - Motors can last 20+ years, locking-in electricity waste
  - Become destination for inferior motors not accepted elsewhere



# Motor System Improvements



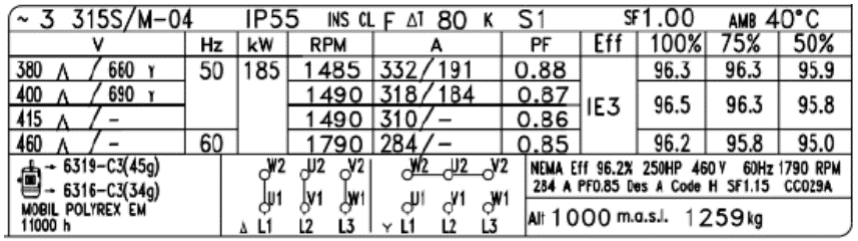
# Sample Recommendations for Policymakers

## Standards

- ✓ Domestic motor manufacturing: adopt MEPS at IE2 and timetable for graduating to IE3
- ✓ No domestic motor manufacturing: adopt MEPS at IE3

## Supporting Policies

- ✓ IEC 60034-30-1 nameplates on all motors
- ✓ Professional repairs per ANSI/EASA AR100




## Monitoring, Verification and Enforcement

- ✓ Implement MVE in national legal framework in time for the adoption of MEPS
- ✓ Measure motor efficiency per IEC 60034-2-1

## Financial Mechanisms

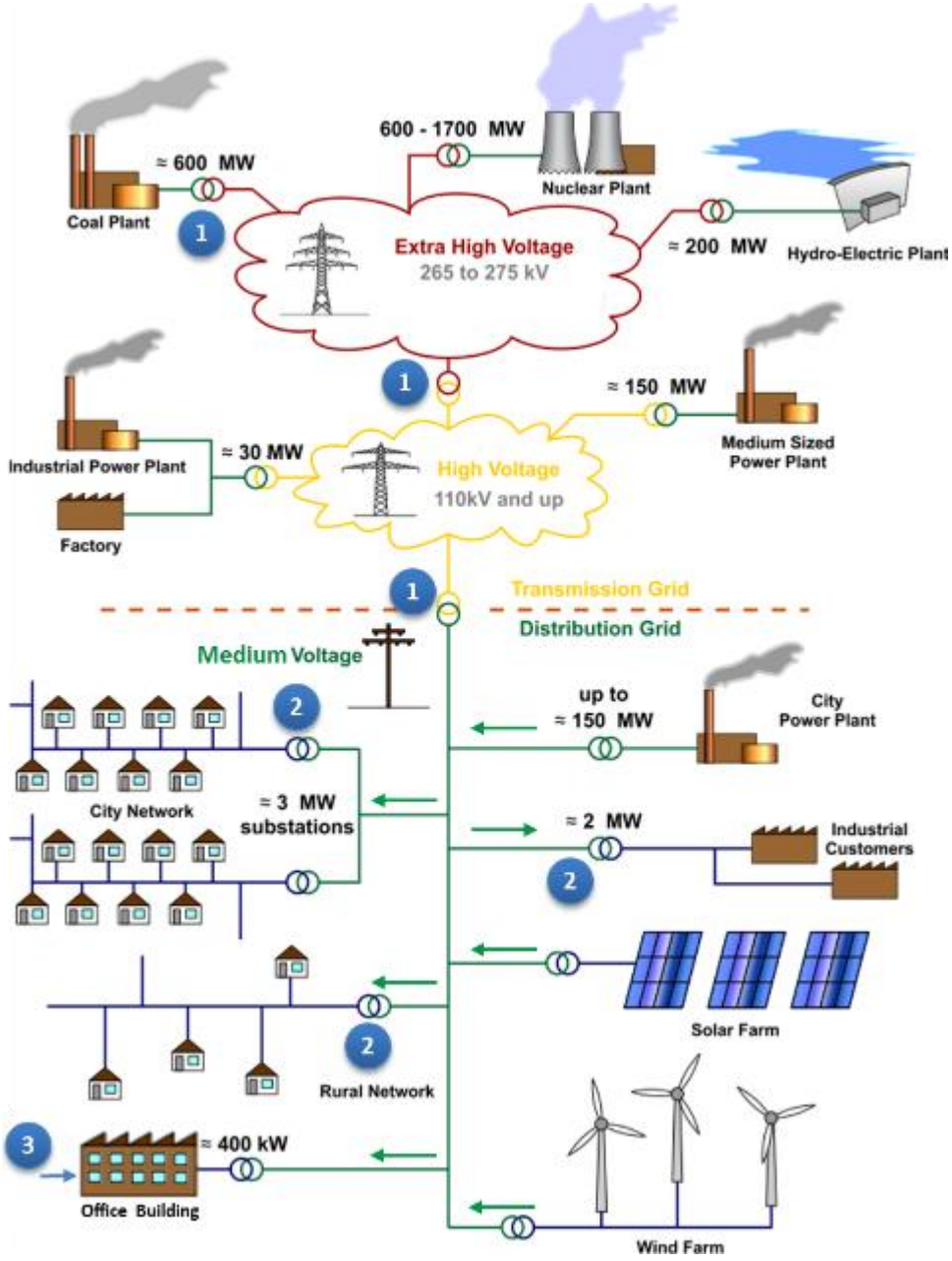
- ✓ Assess existing finance sources and conduct analysis to understand financial barriers so applicable delivery mechanisms can support voluntary actions

## Environmentally Sound Management and Health

- ✓ Collect and process cast iron, steel, aluminium, copper, stainless steel and brass parts (98% of motor content) that are fully recyclable

# Energy-Efficient Transformers Policy Guide

# Transformers




## Background

- Static devices that transfer electrical power between circuits
  - ➢ Losses proportional to current in wire: increase voltage & decrease current
- Huge impact on energy, environment
  - ➢ Operate non-stop
  - ➢ Lifetimes of 25 years or more
  - ➢ Lose nearly 5% of global electricity
  - ➢ Stock will nearly double by 2030

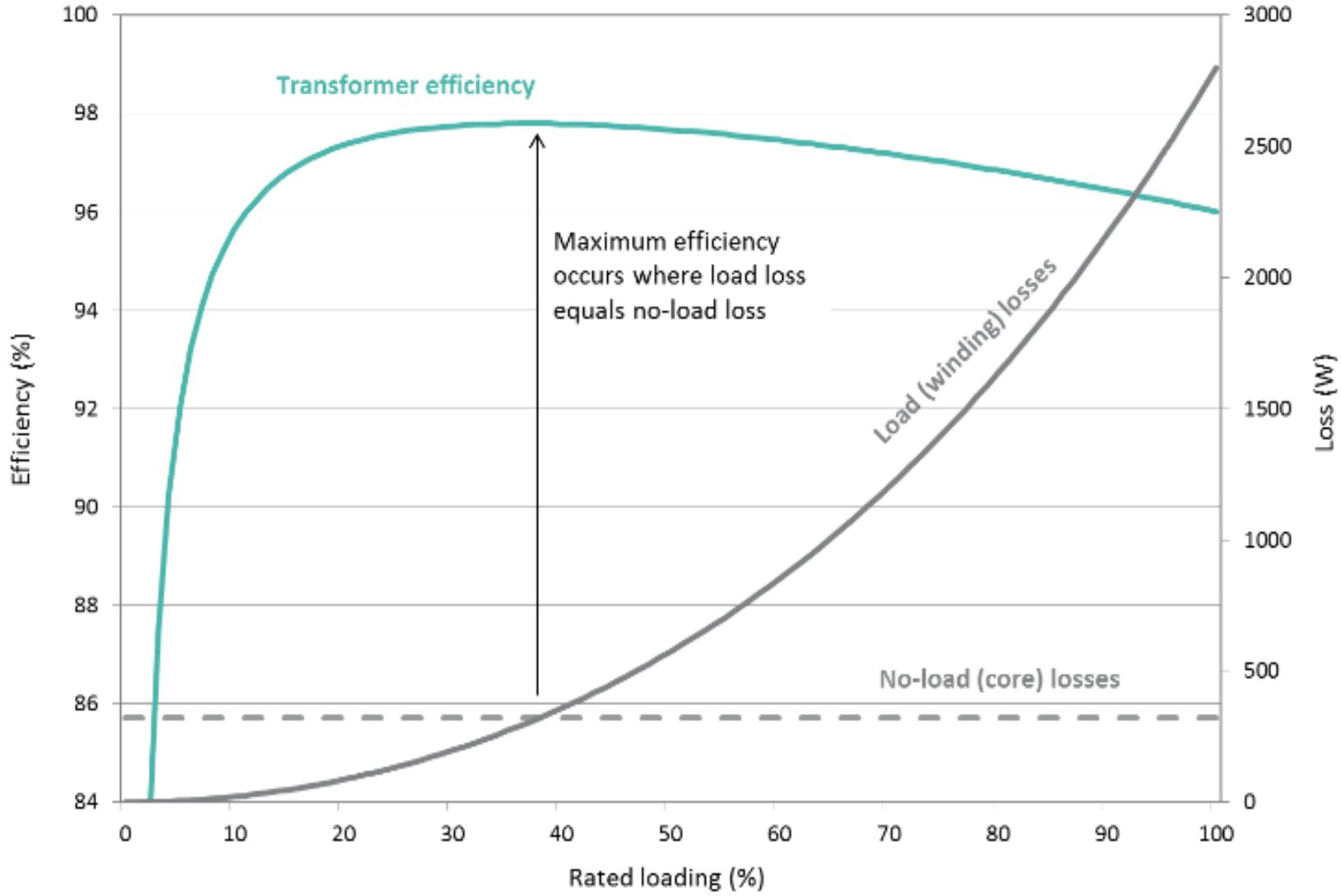
# Focus of the Policy Guide

## Main Power Transformers

## Distribution Transformers

| Group | Voltage | Phases | Insulation | Common Use |
|---|---|---|---|---|
| **Large Power** | >230 kV | Single & Three | Liquid-filled | Step up or down voltage for transmission over long distances; substation transformers |
| **Medium Power** | >36 kV & ≤230 kV | Single & Three | Liquid-filled or dry-type | Stepping voltages down from a sub-transmission system to a primary distribution system |
| **Medium Voltage Distribution** | ≤36 kV | Single & Three | Liquid-filled or dry-type | Step down voltage in a distribution circuit from primary to secondary voltage |
| **Low Voltage Distribution** | ≤1 kV | Single & Three | Dry-type | Step down voltage in a building distribution circuit or to supply power to equipment |

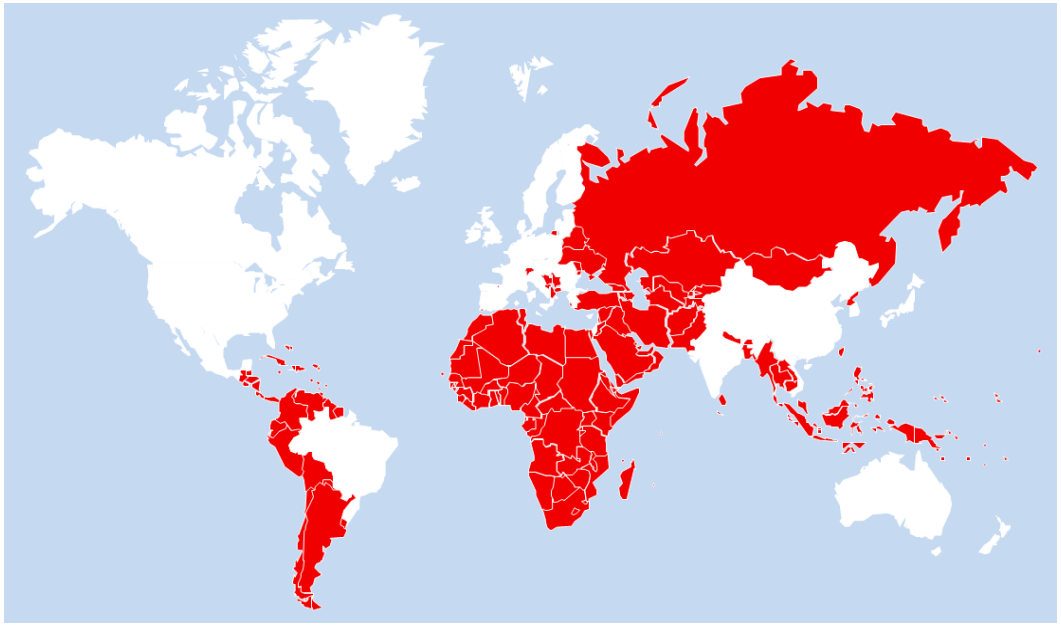
# Loss and Efficiency Relationship



# Why Leapfrog to Energy-Efficient Transformers?

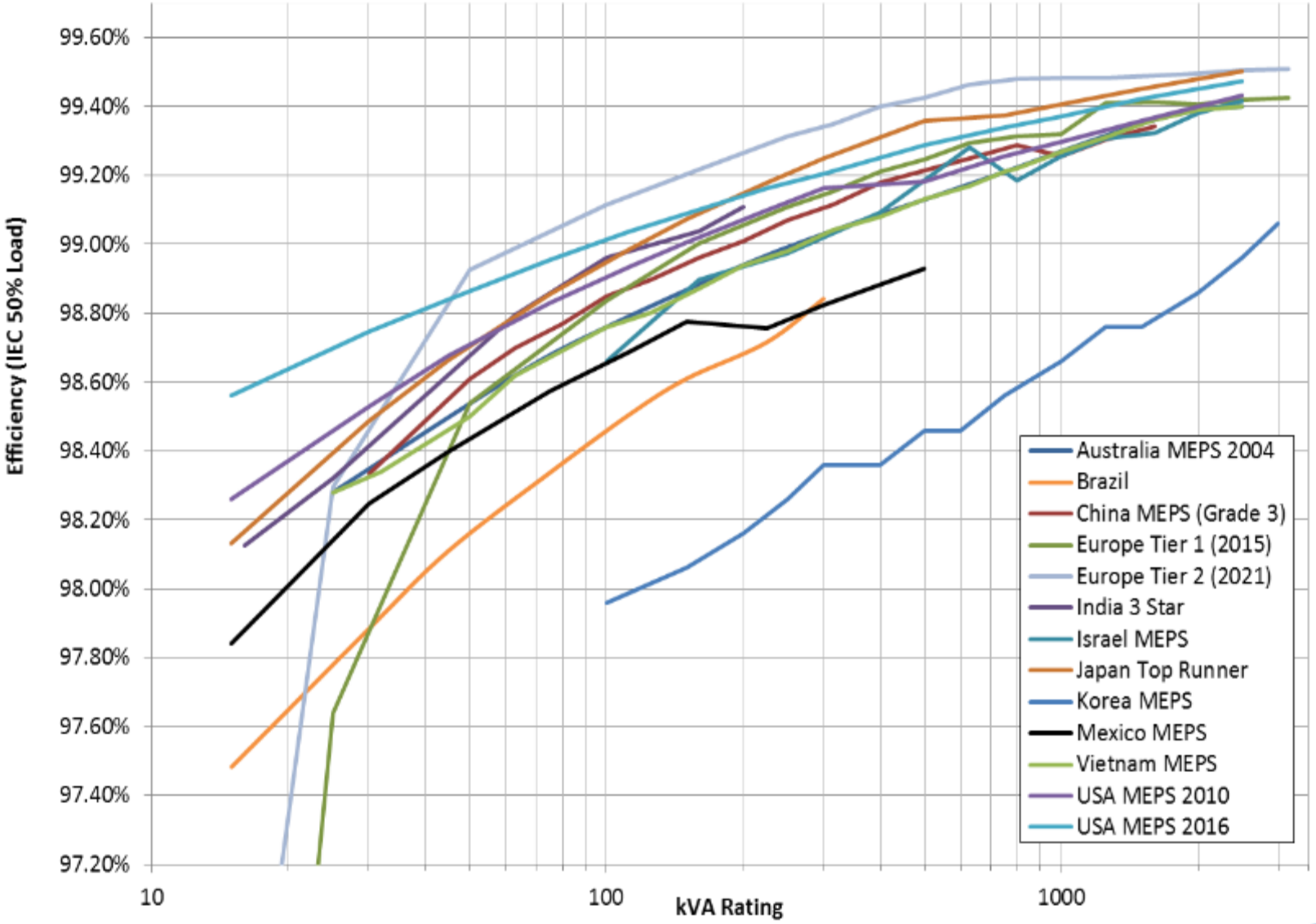
**13 of the world's largest economies undergoing a market transformation**

- Very attractive when considering the total cost of ownership
- Significant risks of inaction: lock-in decades of electricity waste
- Savings potential: **400 TWh** and **250 million tonnes** of $CO_2$ emissions in 2030



Countries (in red) lacking national mandatory efficiency policies for distribution transformers

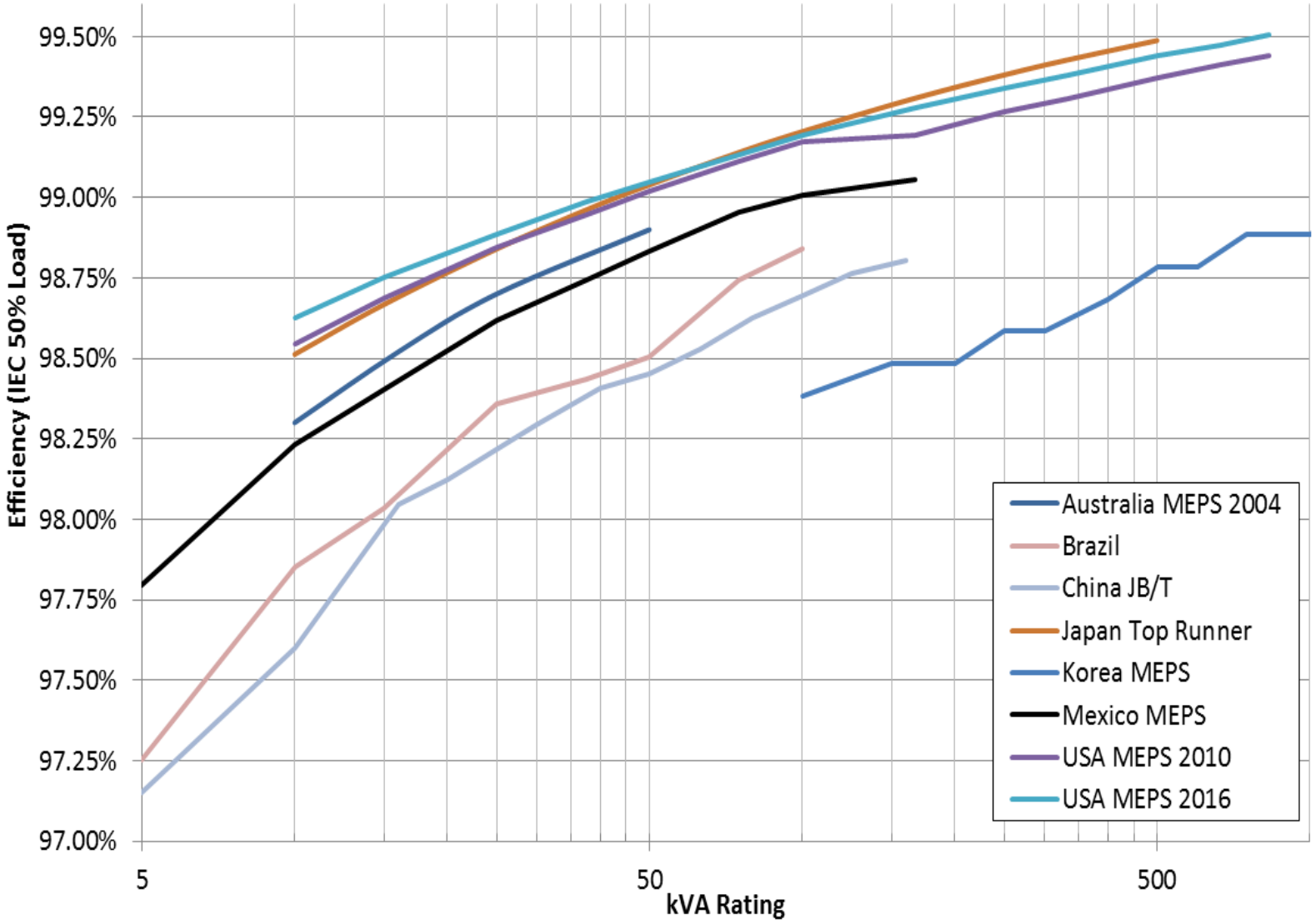
# Examples of MEPS




Source: SEAD Standards & Labelling Working Group Distribution Transformers Collaboration. Part 1: Comparison of Efficiency Programmes for Distribution Transformers. December 2013

## Three-Phase Liquid-Filled Transformers

# Examples of MEPS




Source: SEAD Standards & Labelling Working Group Distribution Transformers Collaboration. Part 1: Comparison of Efficiency Programmes for Distribution Transformers. December 2013

## Single-Phase Liquid-Filled Transformers

# Sample Recommendations for Policymakers

## Standards

✓ Aim to adopt MEPS with test method IEC 60076

## Supporting Policies

✓ Labels

✓ Communication campaigns

## Monitoring, Verification and Enforcement

✓ Implement MVE in national legal framework in time for the adoption of MEPS

## Financial Mechanisms

✓ Encourage the adoption of purchasing practices that are based on the total cost of ownership over a transformer's lifetime, rather than on the first cost.

## Environmentally Sound Management and Health

✓ Follow guidance from the Stockholm Convention on Persistent Organic Pollutants for locating, handling and disposing of PCB contaminated equipment.

# Contact

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