Accelerating the Global Adoption of

ENERGY-EFFICIENT TRANSFORMERS

POLICY GUIDE SERIES

Nearly **5 per cent** of global electricity is lost by transformers each year

Over the next two decades, such **losses** are projected to **rise** as economies expand and **additional electrical capacity** is added

Globally, the installed stock of **transformers** will more than **double** by 2040. Over that time, Africa's installed stock of **transformers** is expected to more than **triple**

Countries can **save more** than the annual **electricity generated** by approximately **100 coal-fired power plants** by **using more efficient transformers**

Model **policies** in **Europe** have shown a **reduction** in transformer **losses** resulting from **regulatory measures** adopted in 2014. This absolute reduction in losses, concurrently with a **growth** in **electricity consumption** in Europe, demonstrates the **effectiveness** of **policy instruments**

United for Efficiency helps developing and emerging economies transition to **more energy-efficient transformers**

BACKGROUND

Transformers are static devices in electricity systems that transfer electrical power between circuits. Their application in electricity transmission and distribution enables significant energy savings by increasing the voltage and decreasing the current, since losses are proportional to the amount of current flowing through the wire.

The most common type is a liquid-filled transformer with windings that are insulated and cooled with mineral oil or another liquid. These are typically used outdoors by electric utilities.

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Typical liquid-filled (left) and dry-type (right) transformers

Transformers operate non-stop and have long service lifetimes, typically exceeding 25 years. Although most transformers have efficiency levels greater than 98 per cent, even slight efficiency improvements can add up to significant energy and emissions savings over the lifetime of the equipment.

Nearly 5 per cent of global electricity is lost by transformers. In 2016, this loss was about 1,100 TWh worldwide, which is equivalent to the annual electricity consumption of Japan.[1] Over the next two decades, such losses are projected to rise as economies expand and additional capacity is added.

The market penetration of highly efficient transformers has significant room for growth. While policy measures are being adopted in the world's largest economies to encourage market penetration, the vast majority of markets are largely untouched.

Many countries (in blue) do not have national mandatory efficiency policies for distribution transformers.

1 *UN Environment estimate, based on country transformer market assessment, 2017.*

2 *SEAD Standards & Labelling Working Group Distribution Transformers Collaboration. Part 1: Comparison of Efficiency Programmes for Distribution Transformers, 2013.*

WHY LEAPFROG TO ENERGY-EFFICIENT TRANSFORMERS?

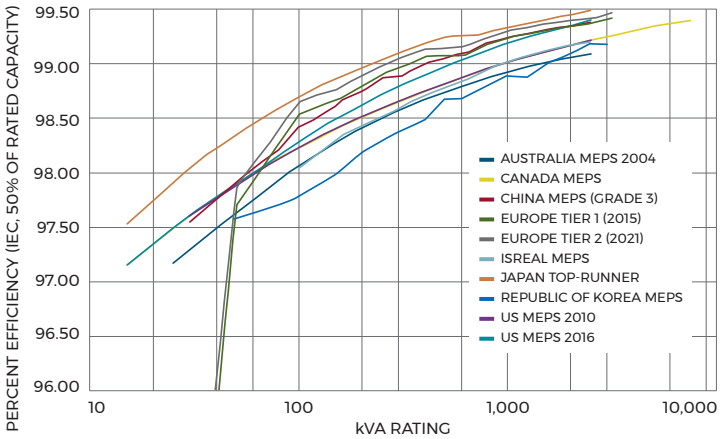
The global stock of transformers will nearly double over the next 15 years. Now is the time for developing and emerging economies to adopt robust policies to ensure that this demand is met by energy-efficient products.

Getting this transition right unlocks multiple benefits for governments, businesses and consumers. There are useful examples from around the world of how such improvements yield lower electricity bills for residents and businesses, reduce peak loading at power plants and related pollution, enhance safety and reliability and prevent contamination by hazardous substances.

These benefits can only be realised through a widespread and lasting shift to energy-efficient technologies.

Technical solutions to improve the energy efficiency of transformers are commercially available, ranging from better core construction techniques and decreased flux density to using lower-loss core and conductor materials, among others.

Fortunately, there are proven ways to accelerate the adoption of high-performance equipment and eliminate out-dated technologies from the market. Well-designed and implemented policies can enable developing and emerging economies to reduce transformer electricity consumption by 400 TWh and mitigate 250 million tonnes of CO_2 emissions each year by 2030.

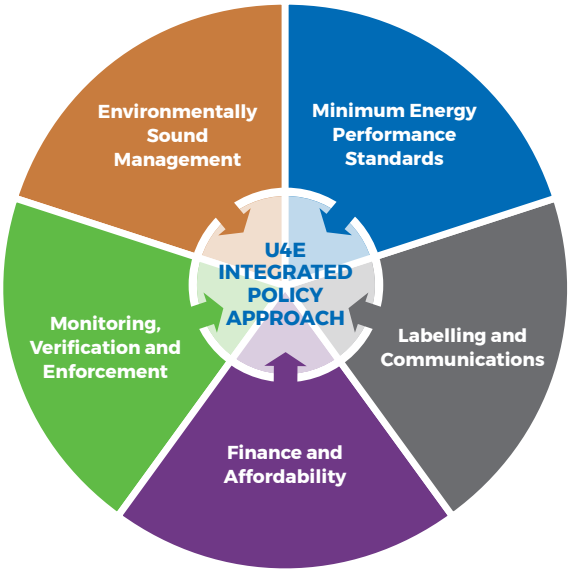


Example of minimum energy performance standards (MEPS) for three-phase liquid-filled transformers.[2]

Payback periods for energy-efficient transformers vary with the equipment, electricity costs, and the cost of capital. They can be as short as one year and up to six years or more. A six-year payback on a product that typically lasts more than 25 years is an attractive investment if appropriate financial mechanisms are available.

RECOMMENDATIONS FOR POLICYMAKERS

Policymakers are encouraged to follow United for Efficiency's *Integrated Policy Approach* to transform their markets. A National Efficient Transformers Strategy should be developed to show how such a transformation is to unfold in the years ahead.



The strategy development process brings key stakeholders together to foster a shared vision for the market and to identify the resources and mechanisms needed to pursue it. Policymakers should collaborate with others in the region to harmonise standards according to international best practices, and to share resources and lessons learned.

An Integrated Policy Approach includes:

Standards and regulations that define which equipment will be blocked from the market (for failing MEPS), which equipment may be recognised for meeting higher performance and quality requirements, how to test the equipment, and other aspects. Aim to adopt MEPS with test method IEC 60076.

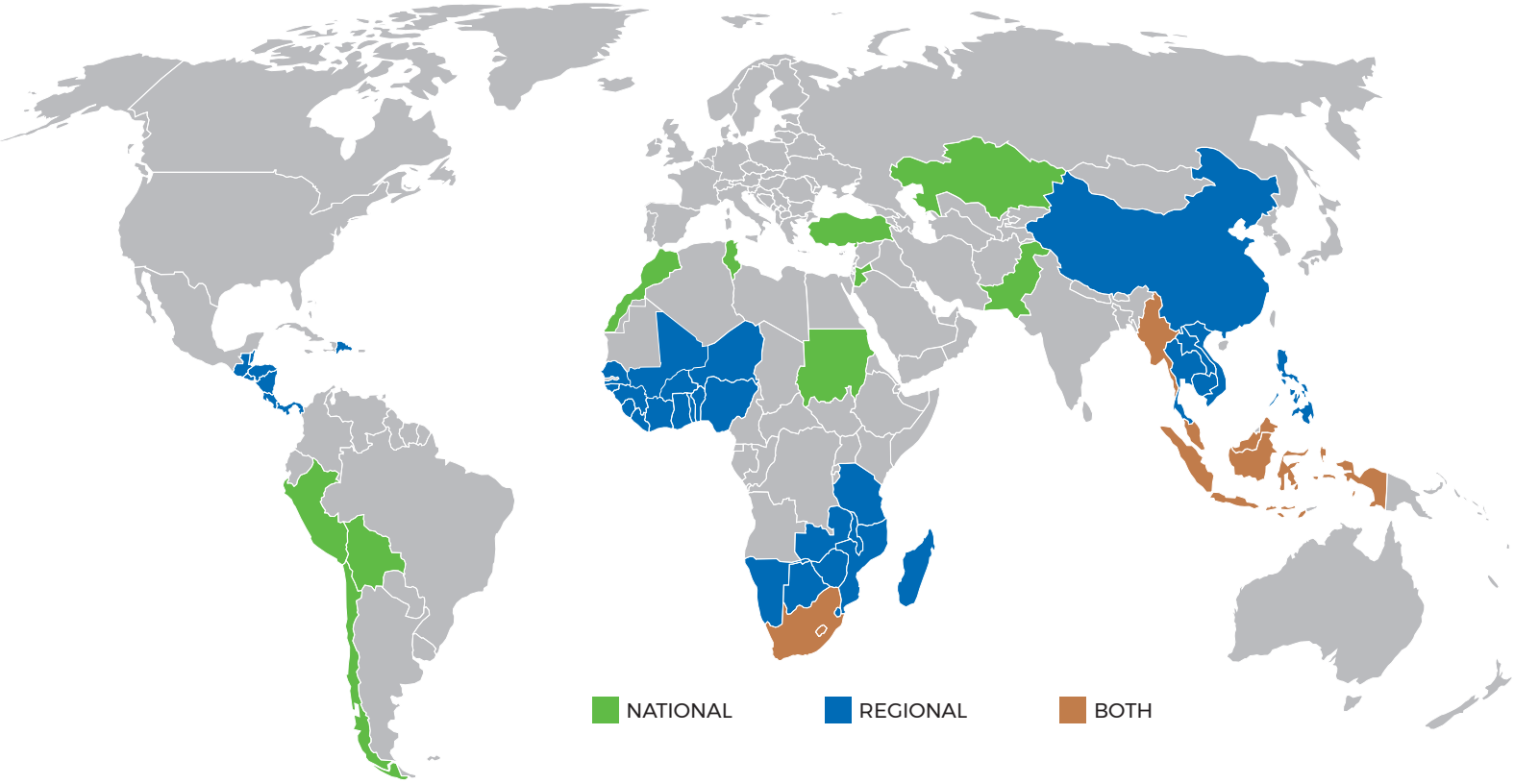
Labelling and communications that ensure the smooth implementation of standards and regulations and achieve broad acceptance. Labels that indicate the performance of the equipment and allow for easy comparison between competing products should be adopted. Awareness campaigns should help purchasers make more informed decisions based on the total cost of ownership of the equipment and help modify behaviour (e.g. encouraging the timely repair of equipment by certified technicians).

Monitoring, verification and enforcement (MVE) to track which equipment is sold in the market, test the equipment to ensure that claims of performance are accurate and to prompt corrections by those that fail to comply. Otherwise, incentives intended for efficient equipment may reward sub-standard alternatives and non-compliant equipment will enter the market. Aim to implement a MVE regime within the national legal framework in time to coincide with the adoption of MEPS.

Financial mechanisms help address the barrier of higher upfront costs of efficient equipment through incentives such as grants, rebates and tax-relief, or by extending credit lines, partial risk guarantees, loans, bulk procurement opportunities and services through energy service companies. 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.

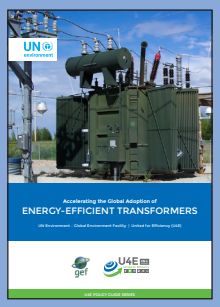
Environmentally Sound Management and Health considerations are crucial given that polychlorinated biphenyls (PCBs) are hazardous substances that must be removed from much of the installed stock of transformers. Follow guidance by UN Environment and the Stockholm Convention on Persistent Organic Pollutants for locating, handling and disposing of PCB contaminated equipment. Pay special attention to maintenance activities, to mitigating the spread of contamination and to the development of a legal framework for recycling and recovery. Due to scrap metal value, transformers already enjoy a high-level of recycling of units taken out of service.

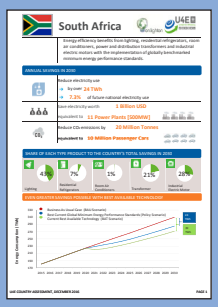
CURRENT UNITED FOR EFFICIENCY NATIONAL PROJECTS AND REGIONAL HARMONISATION ACTIVITIES



ABOUT UNITED FOR EFFICIENCY

United for Efficiency is a global initiative led by UN Environment, funded by the Global Environment Facility, and supported by leading companies, expert organisations and public entities with a shared interest in transforming markets for lighting, appliances and equipment.





Download the full policy guide and review the 150 United for Efficiency Country Savings Assessments at our website.

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