Integrated Resource Planning Training for Decision Makers

Day 4, Session 7 – Efficiency measures to reduce demand growth

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Agenda

- **The role of energy efficiency in an IRP**
  - Seeking to provide holistic least-cost approach to energy sector planning
- **Energy efficiency in least cost planning**
  - Baseline or frozen scenario
  - Energy efficiency potential by end-use sector
  - Energy efficiency cost curves
  - Establishing energy efficiency scenarios
- **Policies and programmes for energy efficiency**
  - Barriers to energy efficiency
  - Policies and programmes for addressing barriers

Day 4, Session 7 – Efficiency measures to reduce demand growth

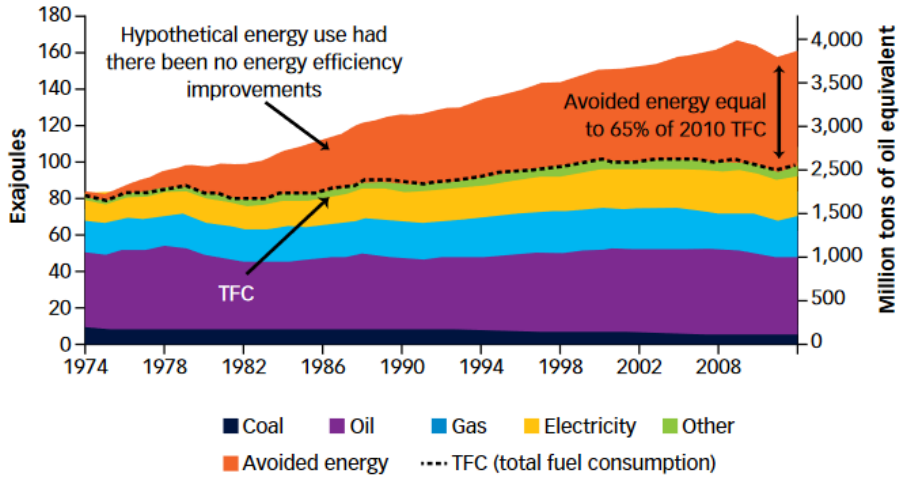
The role of energy efficiency in an IRP

Energy efficiency in least cost planning
Policies and programmes for energy efficiency

Energy efficiency has been central to the IRP concept since inception

- **The 1970s oil crises necessitated a focus on energy efficiency**
  - Efficiency was a major lever to reduce demand and dependence on oil
- **EE made the greatest contribution to meeting energy demands 1974-2010** (IEA 2013)
- **Focusing on demand was therefore a key driver of IRP concept and least-cost generation planning**
- **Energy efficiency is a key resource**
  - "Among the cheapest and cleanest energy resources available" (World Bank)
  - EE can meet 30% of U.S. electricity demand over ten years (RAP 2016)
  - Efficiency could achieve 40% of the reductions needed to meet Paris agreement (IEA 2015)

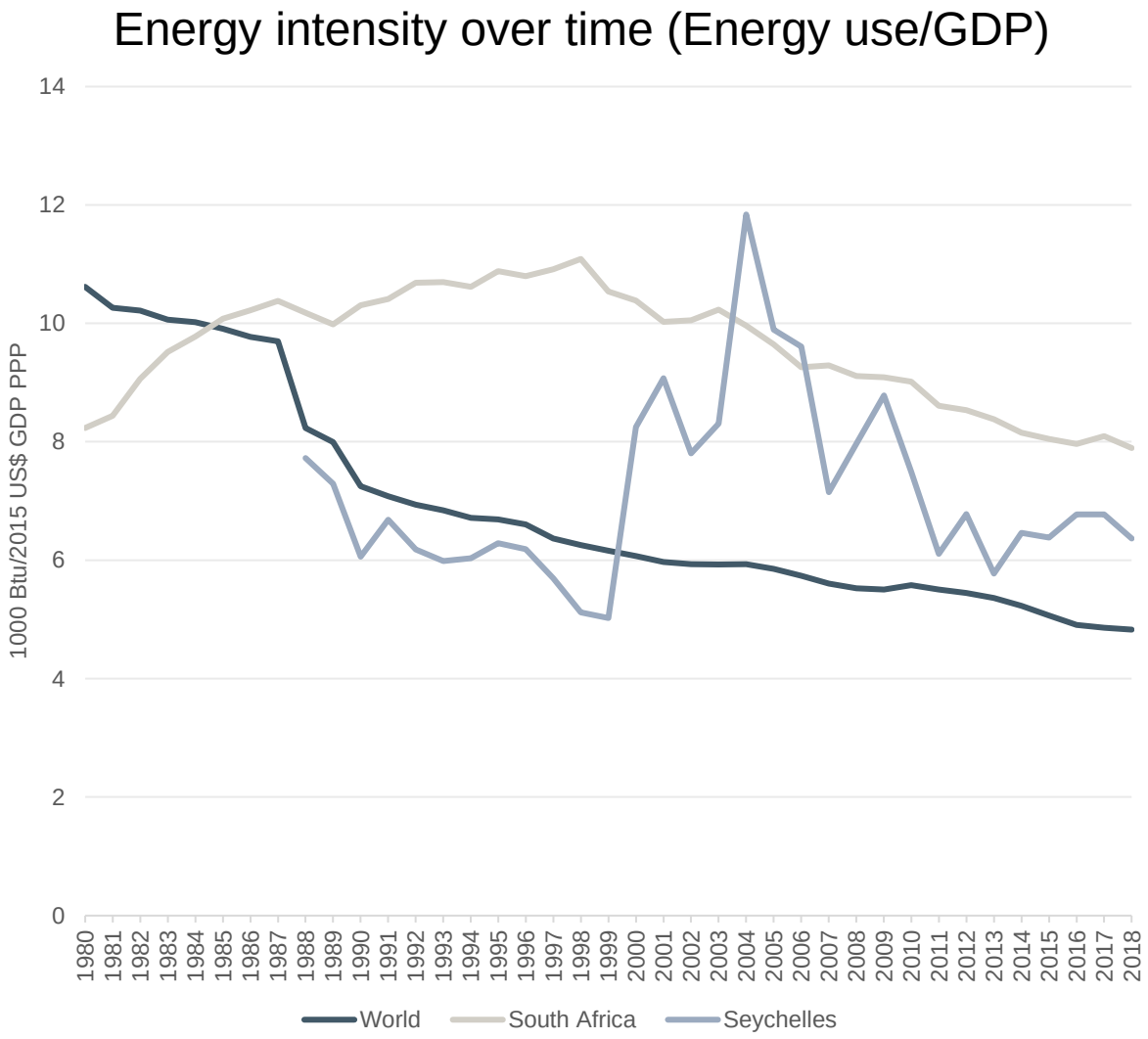
Energy generation and avoided energy use in 11 IEA countries



(IEA, 2013)

Defining energy efficiency

- Energy efficiency - improves when a given level of service is provided with reduced energy input or service is enhanced with fixed energy input
  - Maximises delivery of energy service while minimizing costs and negative impact of energy supply
- Energy intensity – quantity of energy required per unit output
- Energy intensity acts as a proxy for energy efficiency
  - Generally, reduces as countries' income grows
    - Structural factors (ie. size of energy intensive industry)
    - Behavioural factors (ie. age)



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Setting up our counterfactual

- **Need to establish a counterfactual scenario against which to compare improvements**
  - **Baseline scenario** – 'business as usual' includes underlying degree of efficiency improvements as technology improves and equipment is replaced (ie. some improvement in energy intensity)
  - **Frozen scenario (static)** – assumes no efficiency improvements. Based on expected growth of energy-services (ie. energy intensity per end-use sector is maintained)
  - **Dynamic frozen scenario** – Allows for replacement of retired equipment with new more efficient models, but does not allow for new technology

	Baseline	Frozen
Strengths	• Realistic assumption of improvements in technology • May coincide with official forecast (especially where IRPs are not common)	• Simplifies the process as level of energy services can index to measured present consumption
Weaknesses	• Adds level of complexity as need to predict assumptions • Difficulties in measuring level of energy service • Using official forecast may not provide sufficient detail	• Not a true or realistic scenario

Potential EE measures

- Different EE measures will be relevant for different end-users, sectors, and countries
- Measures vary significantly in scale, cost, and EE potential
- Some measures can be implemented within a short time period (e.g. lighting) whereas others require longer time periods (e.g. EE buildings)

Sector	Potential EE measures
Residential	• Improved home insulation • Heat pumps • Domestic appliances
Commercial	• Heat pumps for buildings • Improved lighting
Industrial	• Industrial machinery • Heat pumps for buildings • Improved lighting
Public sector	• Street lighting • Transport fleets • EE in public procurement
Mobility	• Electric vehicles • Fleet renewal

Establishing the energy efficiency potential

Different definitions of EE potential

EE Potential	Definition
Technical potential	Improvements in end-use EE that could result if **most efficient technologies** known today were to **attain 100% market saturation** during one lifetime of the technology (10-20 years)
Economic potential	EE improvement that results from maximum **use of cost-effective technologies**
Market potential	Improvement that results from the use of EE measures **which can be effectively implemented**

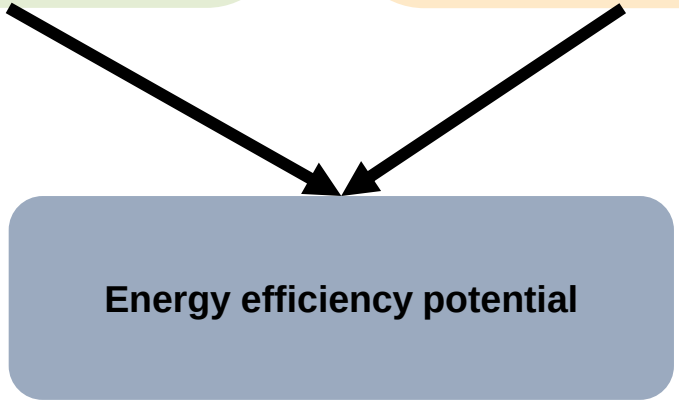
Method to estimate EE potential

Develop list of potential EE measures and savings per measure

- Review of existing policies
- International comparisons

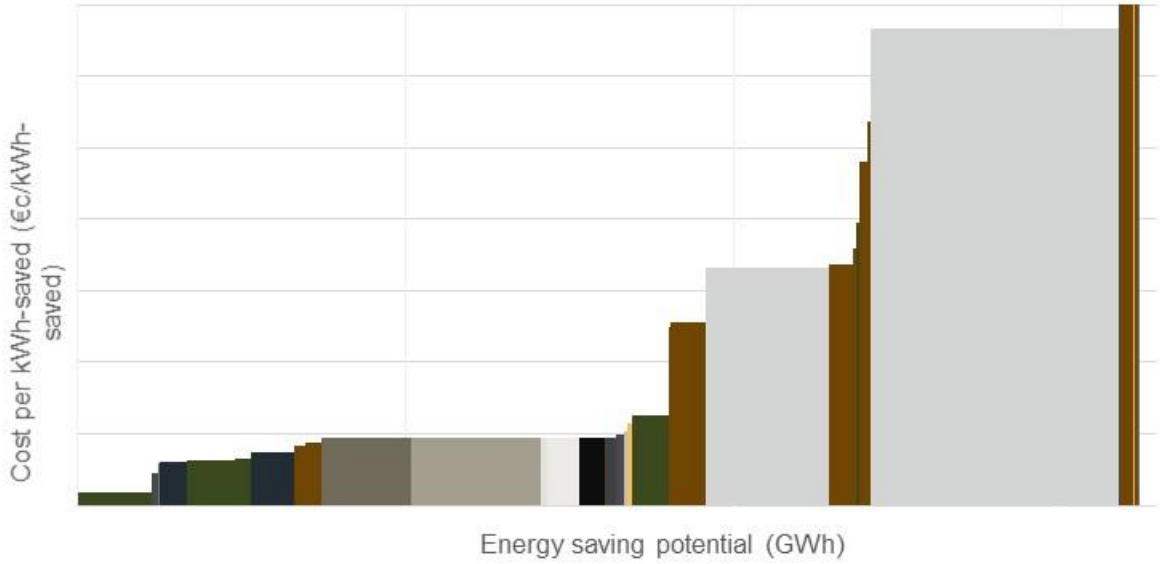
Analyse potential demand for EE measures

- Measure overall market size (surveys, census and statistical information)
- Assess savings per measures – common methodologies



Creating energy efficiency cost curves

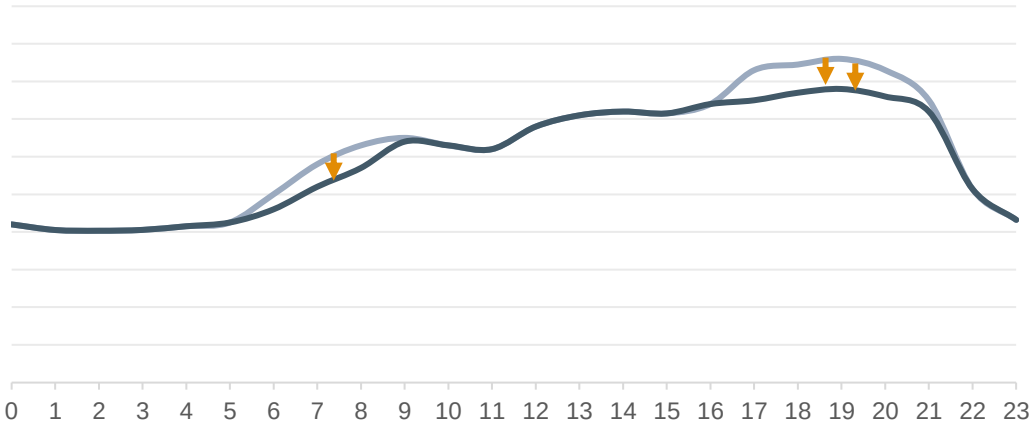
- **Estimate costs of different EE measures**
  - Market prices (good for common, repeatable measures such as appliances)
  - Energy audit results (good for bespoke applications among large users)
  - International benchmarking (including cost per unit saved)
- **Develop cost curves to show the marginal cost of energy savings**
  - **Cost curve ranks measures from lowest to highest cost (investment and operational cost) per kWh saved**
  - Can show different category of measures



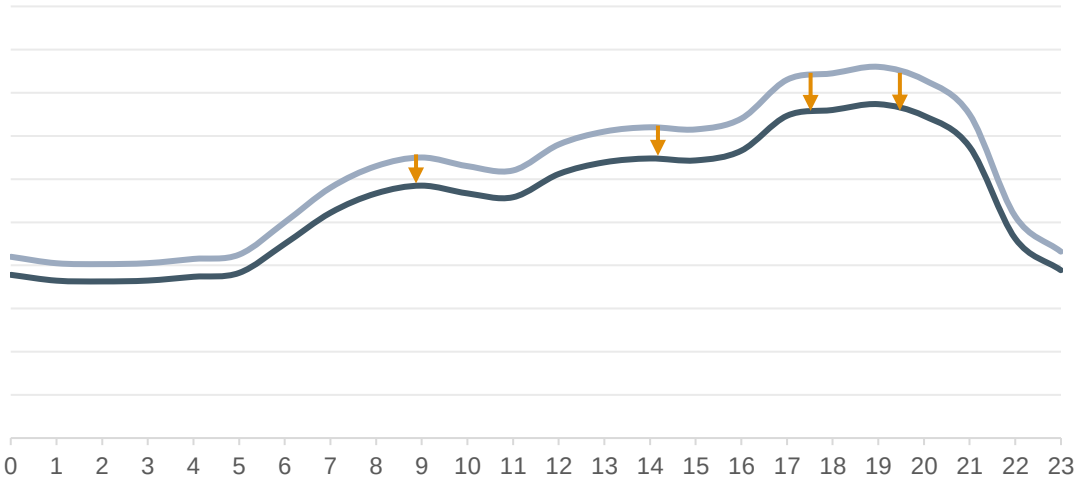
Temporal usage patterns also effect attractiveness

- **Effect of EE measures in least-cost planning go beyond simply reducing demand**
- **Different measures can impact daily load curve of different ways**
  - For example, if peak demand occurs in evenings, EE measures related to electric cooking or heating (depending on the local context) can reduce peaking
- **Can have an impact on the extent of extra generation needed**
- **Potential for integration with domestic storage and demand response**

Peak clipping (e.g. improvements in cooking or heating EE)



Energy conservation



Optimising demand and supply

- **2 different methods to incorporate EE into least-cost planning**

	Alternative candidate resource	Set of demand-side scenarios
Method	• Energy efficiency measures enter the least-cost model as a candidate resource (similar to generation plants) • Least-cost planning software determines the optimal level of EE measures	• Set of demand-side scenarios are developed as an input into the least-cost model • Different scenarios based on assumptions on the market potential and economic attractiveness of EE measures
Strengths	• Estimates the optimal level of EE measures • Treats EE measures as a distinct resource	• Simplified process • Can develop different scenarios with different levels of EE measures to match policy expectations
Weaknesses	• Adds complexity to the model • May require several permutations	• Scenarios may be relatively static or arbitrary • EE not treated as a distinct resource

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The role of energy efficiency in an IRP
Establishing energy efficiency scenarios
Energy efficiency in least cost planning
Policies and programmes for energy efficiency

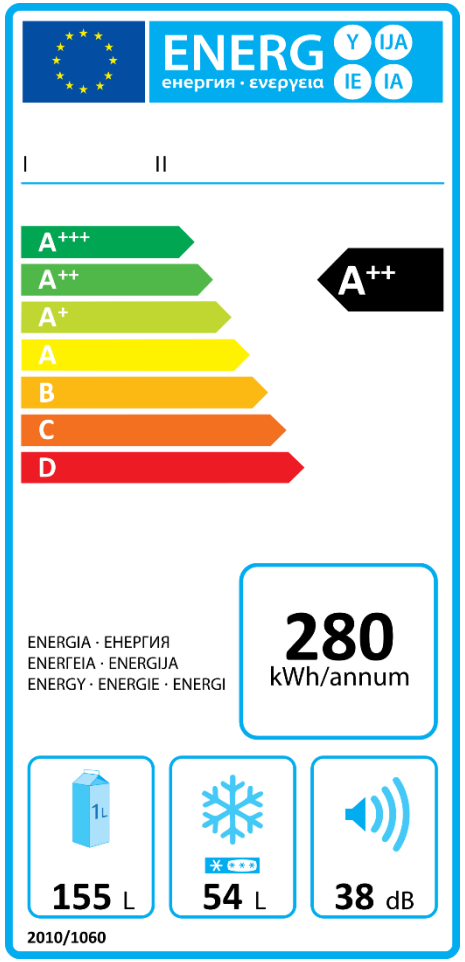
Identify barriers to uptake

- **Economically and financially attractive EE measures can face barriers to uptake**
- **Lack of incentives (eg. non cost-reflective tariffs) inhibit adoption of EE measures**

End-use sector	Common barriers to uptake
Residential	• Lack of information on measures and their potential • Access to capital (especially among low-income households) • Split incentives (landlord/renter) • Rules on common ownership (e.g. multi-family homes) • High transaction costs
Commercial	• Lack of information on measures and their potential • Access to capital (especially among small enterprises) • High transaction costs (especially for small enterprises)
Industrial	• Lack of information • Short investment and decision-making horizon vs long payback period for some EE measures
Public	• Public procurement rules • Budget cycles and incentives

Common policy actions for addressing

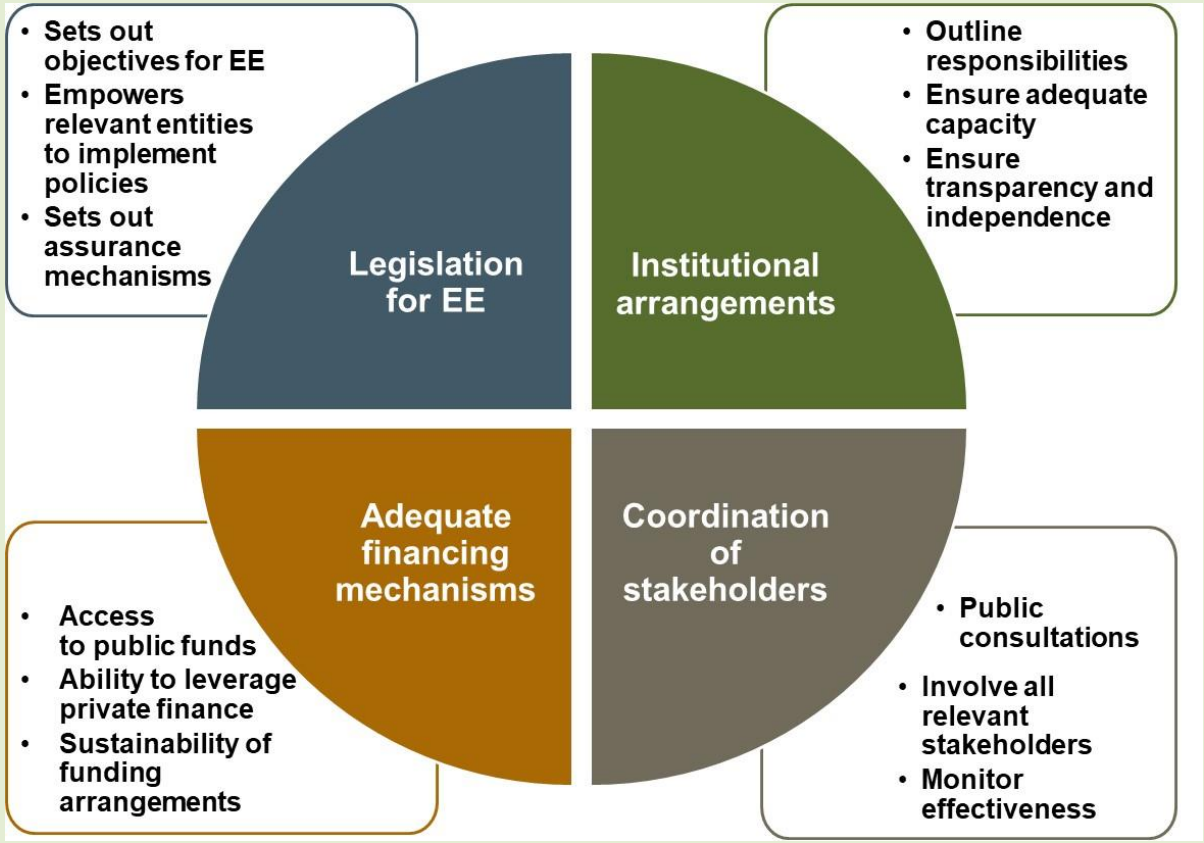
- **Policies can be targeted at overcoming these barriers**
- **These do not usually form part of an IRP**
- **Policies can take various forms, such as:**
  - Financing schemes
  - Fiscal incentives
  - Carbon and energy taxes
  - Training, education and information (eg. labelling)
  - Regulations – eg. Minimum Energy Performance Standard



Implementation framework and challenges

- **Challenges due to the decentralized and small-scale nature of EE measures**
  - Difficulties in verifying implementation and impact of EE measures
  - Difficulties in reaching poorer households
  - Lack of capacity within entities administering schemes
- **Requires stakeholder engagement and consultation**
  - Need to ensure policies and measures are effective
  - Develop buy-in among end-use sectors

Governance framework for implementing EE



Cost-benefit analysis of energy efficiency policies

- **What is financially attractive will not always have highest socio-economic benefit**
- **Conduct a cost-benefit analysis of potential measures**
  - Consider different stakeholders
  - Impacts discounted to NPV

	Benefits	Costs
Direct users (customers)	• Saving in energy bills	• Cost of EE measures and programmes
Utility/electricity sector	• Reduced investment in infrastructure • Reduced operating costs (avoid double-counting savings in energy costs!)	• Lost sales
Broader impacts	• Lower emissions (beyond those captured through savings in emissions trading schemes/carbon tax)	• Opportunity cost of EE programme (subsidies) • Impact on tax revenus (eg. impact on fuel tax collection when switching to EVs)

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Discussion

Energy efficiency scenarios in current IRPs

How are EE measures considered in your country's current planning document?

Energy efficiency scenarios in SADC power planning documents

Botswana: 'Energy demand management measures' scenario considered – BAU with technological progress and EE measures

Mauritius: Energy efficiency factored into demand forecasts

Mozambique: EE discussed but not factored into demand forecasts

Namibia: Review of current and planned programmes. Treated as a reduction in load.

Tanzania: Target EE rate set to reach 0.5% per year after 2026.

Discussion: Opportunities and barriers

What in your understanding are the biggest opportunities and barriers for improving EE in your country?

- Consider by sector:
  - Residential
  - Commercial
  - Public
  - Industry
  - Transport
- What are energy intensive activities where savings are greatest?
- What
- What opportunities do new technologies bring?

Discussion: Policy mix

What policies have been, or are panned, for adoption? What would you like to see considered?

- E.g.
  - Minimum standards
  - Information campaigns
  - Subsidy programmes
- Consider challenges and potential framework for implementing?
- What steps due you believe need to be taken to enable implementation?

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