

# Demand-Side regulation with Energy Efficiency goals

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# Energy Efficiency objectives

**Energy Efficiency** (EE) aims at reducing resources consumption using less energy input to produce the same output.

Motivations to improve EE:

- reduction in energy costs;
- lowering of carbon dioxide (CO<sub>2</sub>) emissions.

The goal is to meet the increasing energy demand implementing EE while extending grids and plants.

# Demand-Side Management

**Demand-Side Management** (DSM) is the modification of consumer demand for energy through various methods such as financial incentives and education.

*One method:* time sensitive prices that change instantaneously

The DSM underlying problem is that electricity use can vary dramatically and the pricing system may not reflect the instantaneous cost.

# Barriers to EE

The adoption of EE measures is hindered by several **barriers**, which may require a public policy intervention

- ▣ economic barriers: market failures
- ▣ economic barriers: non market failures
- ▣ behavioral barriers: explain the consumers' choice failures

These failures explain the **gap** between optimal level of consumption and actual consumption of energy

# Market failures

- Imperfect information

consumers lack relevant information on the EE investment

- asymmetric information

producers of EE equipment are better informed about its characteristics but cannot credibly convey this information

- split incentives

it occurs when the potential adopter of an investment is not the party paying the energy bill (i.e. landlord-tenant)

- externalities

Unpriced environmental externalities from fossil fuel or renewable energy use imply an over use of energy, or an under-use of potential energy efficiency improvements

# Non-market failures -1

## ▣ Hidden costs

associated with information seeking, identifying suppliers, writing contracts

## ▣ credit constraints

solved by loans and financing programs

## ▣ risk

- innovative technology may be unreliable
- long term savings are uncertain (also because of the volatility of energy prices)
- EE investment may have limited scope of diversification and/or limited possibility of resale (embedded within buildings and equipment)

# Non-market failures -2

- ▣ heterogeneity of demand

A technology that is cost effective on average across a population of users taken in aggregate, may not be so for some individuals

- ▣ regulatory failures

If regulated prices fall below marginal cost, then regulation contributes to the efficiency gap in two ways: by increasing demand, and by being a disincentive to the investment in EE

This pricing distortion has a temporal dimension because consumers generally face time-invariant electricity prices

# Behavioral failures -1

- ▣ lack of personal value

consumers may be unconcerned about the value of saving energy

- ▣ inertia and status quo bias

consumers are irrationally reluctant to change behavior or adopt new equipment (endowment effect: people becomes psychologically invested in costs that they have already paid)

- ▣ choice overload

when faced with too much information or too many choices, people tend to do nothing. Policy implications: people are less likely to opt-in to a program if, in order to do so, they must choose between too many options; avoid giving too many energy saving tips; limit the number of different compact fluorescent light bulbs available; offer few packages rather many different options



# Behavioral failures -2

## ▣ extremeness aversion

Individuals tend to choose the option that represents a compromise (people won't buy the cheapest nor the most expensive item) -> adding an irrelevant but extreme alternatives to a choice set may favor intermediate options.

## ▣ loss aversion

losses weight more than gains: consumers systematically undervalue future savings, thus displaying time inconsistency

## ▣ default effect

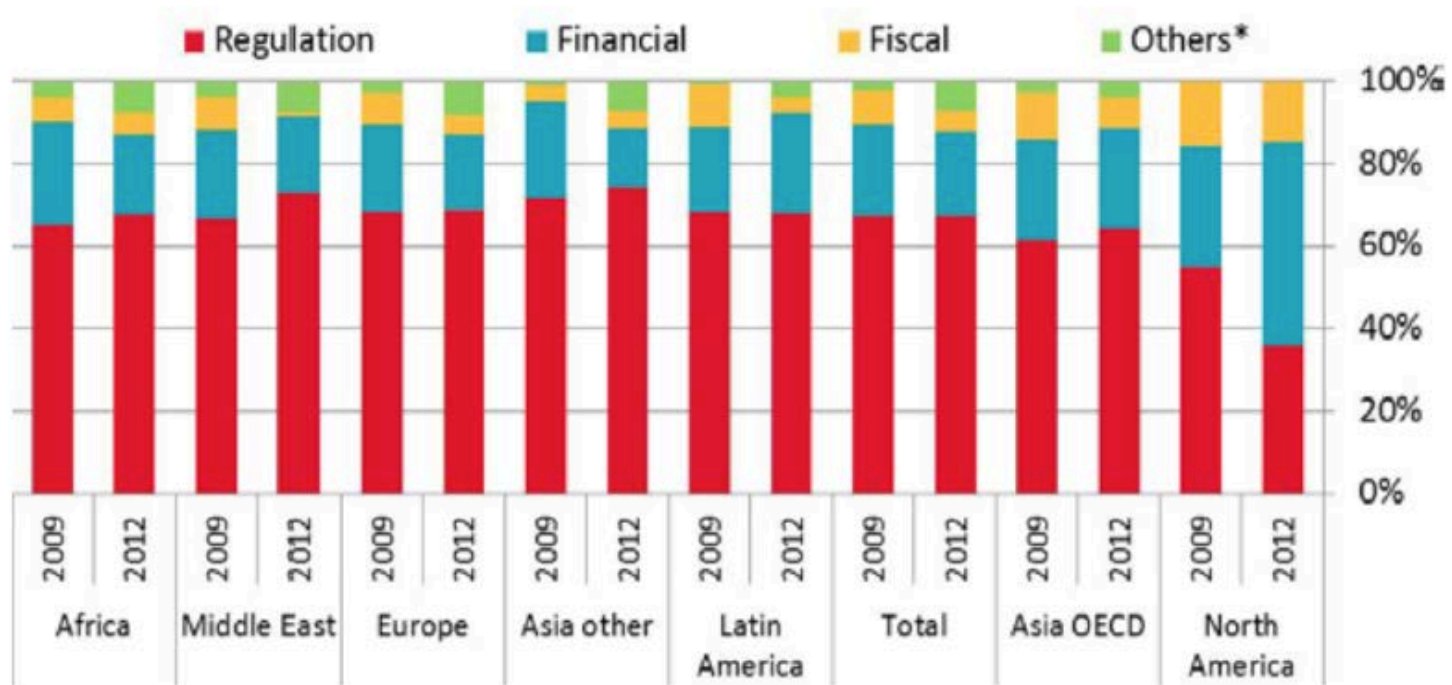
People tend to stick with the default option. Hence, switching a program from opt-in to opt-out could impact the program enrollment

## ▣ bounded rationality

boundedly rational decision making involves not optimizing procedures due to inconsistency, lack of awareness or cognitive limitations (**rebound effect**)

# Policies: classification

- ▣ regulatory measures
- ▣ economic measures
- ▣ information programs



# Regulatory measures: overview

## ▣ regulatory measures:

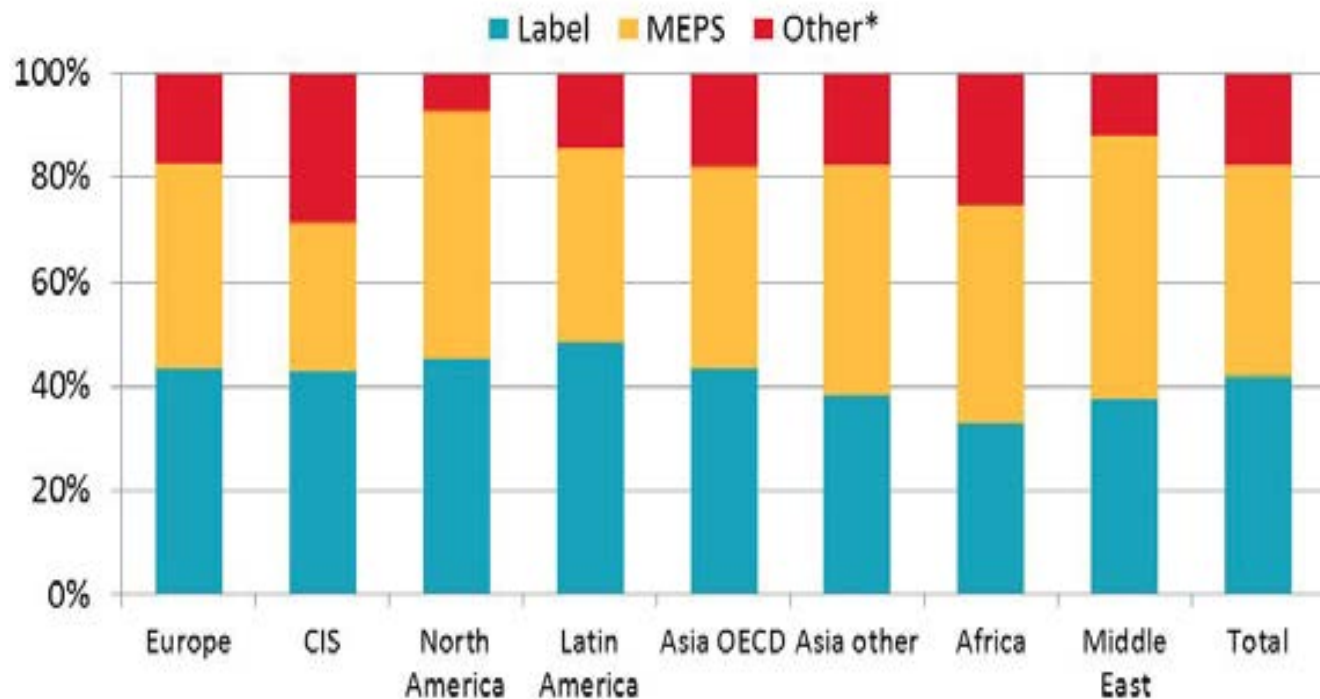
mandatory labels

minimum standards

other regulations (energy audits, energy training, mandatory maintenance...)

time varying pricing

decoupling

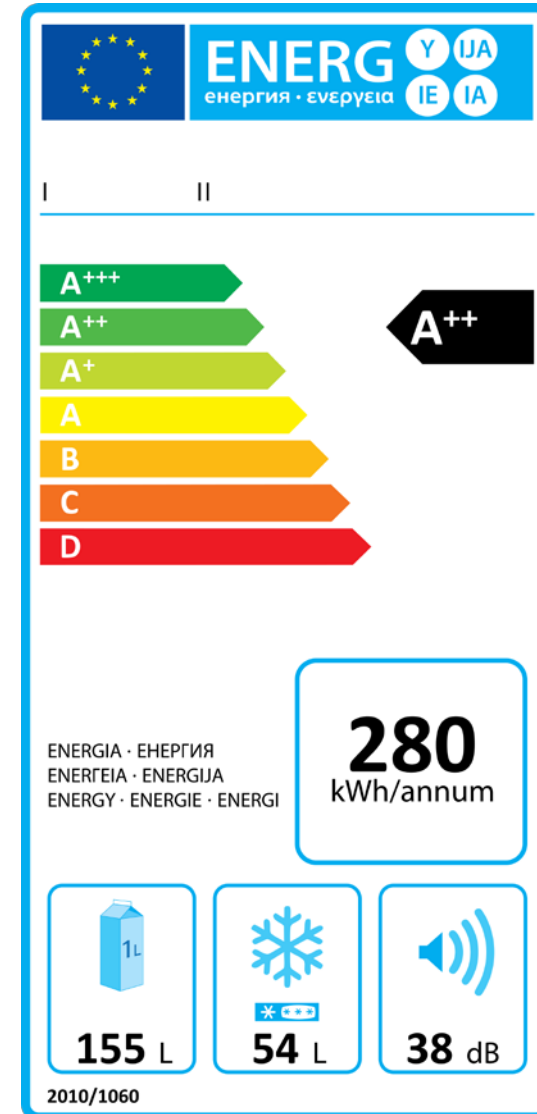


# Labels and standards

Nearly all IEA countries introduced **minimum energy performance standards** (MEPS), that are specifications containing performance requirements for energy-using devices.

For instance, the EU Directive 2010/30/EU established an energy consumption labeling scheme, indicating the appliance's details, an EE rating in terms of classes from A+++ to G, consumption, efficiency, capacity and noise

Reduce the hidden costs related to information seeking activities



# Pricing policies

**Time varying pricing:** tariffs that vary according to the time of use of electricity, so as to reflect more accurately the costs of generation

- time of use (TOU): prices vary in a pre-set manner by time of day or season
- real time pricing (RTP): prices are updated at a hourly or even more frequent basis to directly reflect marginal costs

Reduce the price distortion and induce the consumers' optimal choice of consumption

However: high implementation costs (smart meters)

# Decoupling

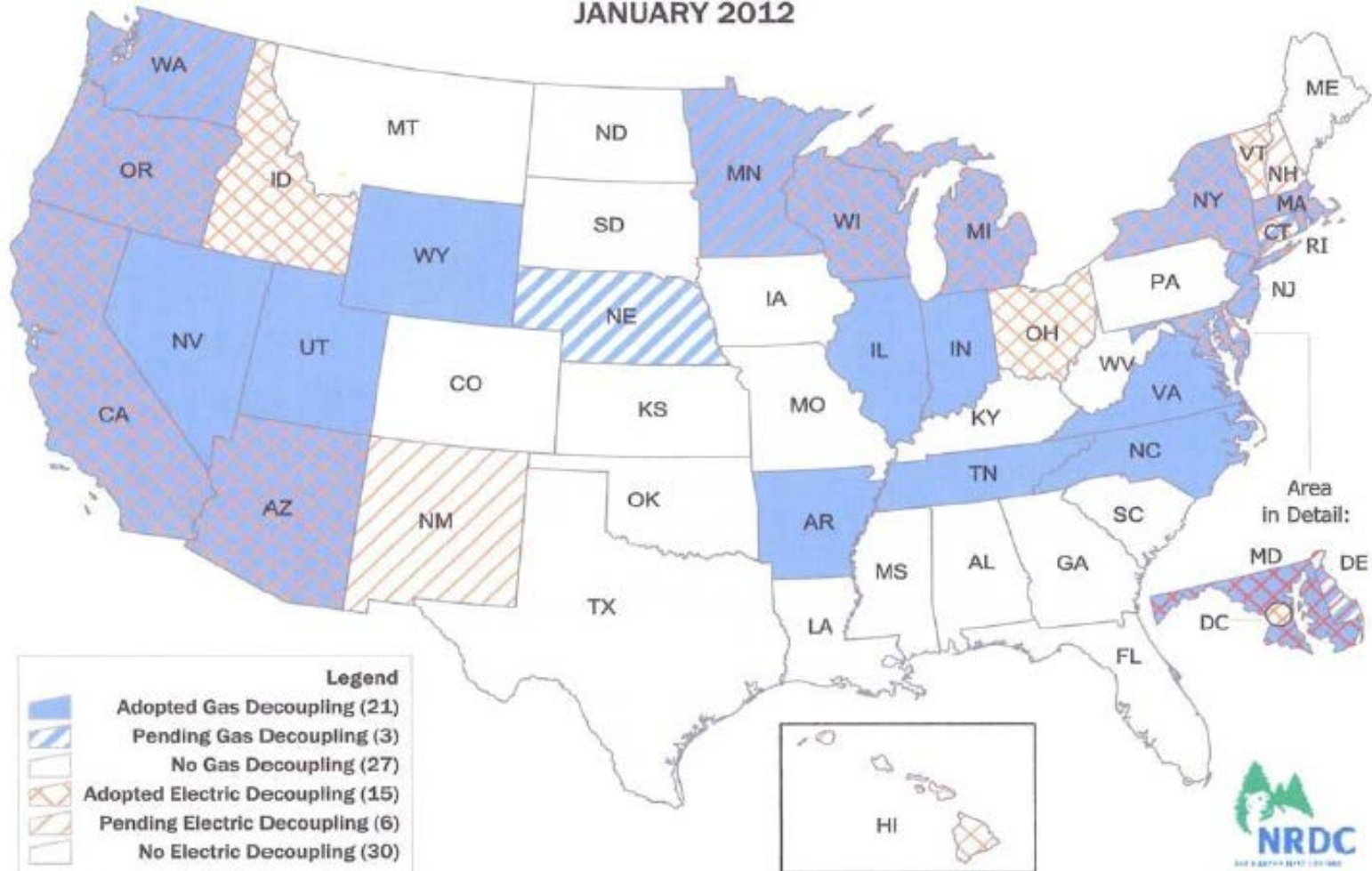
**Decoupling** is a rate adjustment mechanism that breaks the link between the amount of energy a utility sells and the revenue it collects, in such a way to ensure the recovery of the **allowed revenue**

Utilities are thus encouraged to promote the EE by their customers, as the reduction of sales does not impact negatively on the utility's revenue

# Decoupling

## Gas and Electric Decoupling in the US

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# Pros and cons of decoupling

## Pros

- removes the utilities' disincentive to promote EE

## Cons

- it doesn't provide utilities with an incentive to EE either
- by providing revenue stability, it shifts of the risk from utilities to customers
- if customers anticipate that a reduction of consumption will be compensated by a price increase, they have a disincentive to reduce demand
- distributive concerns related to the fixed charge

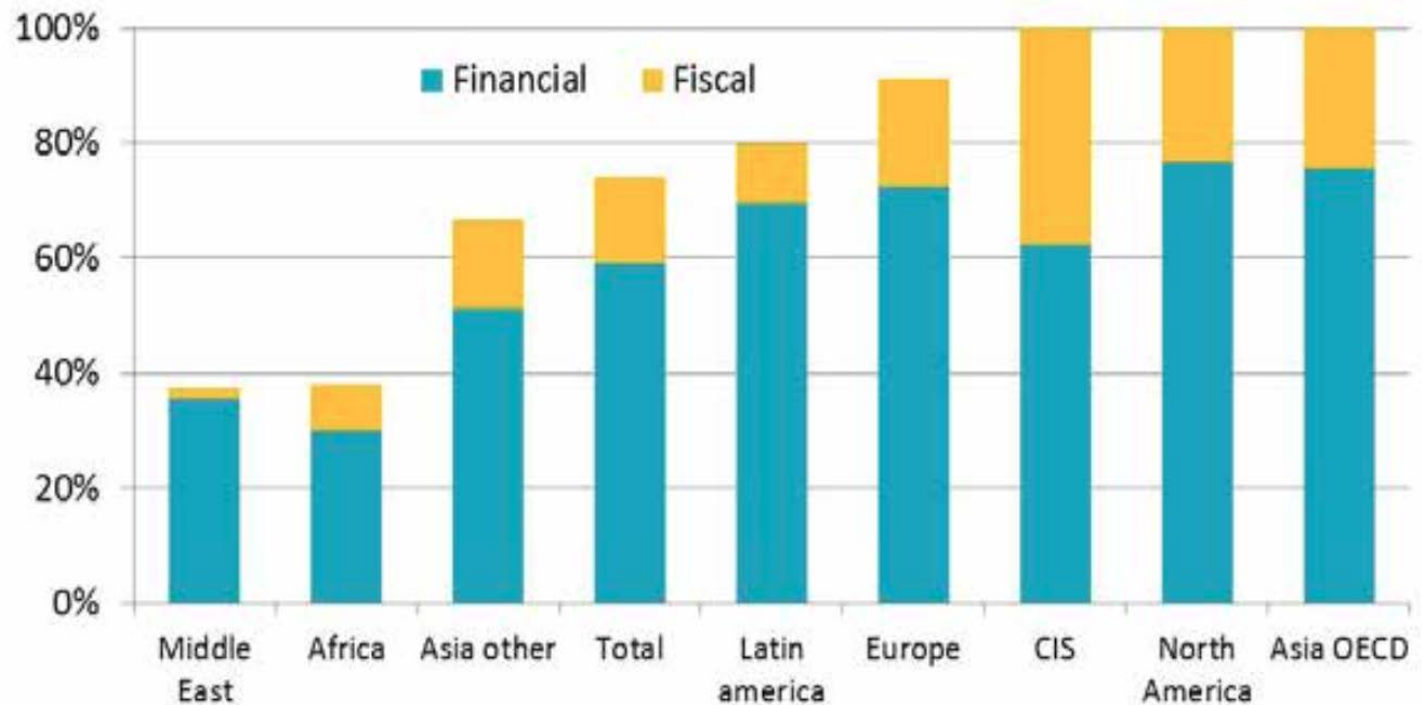


# Economic measures: overview

## ■ Economic measures:

financial incentives (grants, preferential loans, rebates)

fiscal measures (tax reductions, tax credits, accelerated depreciations)



# Economic measures

## ▣ Economic measures

access to capital is a barrier, in particular the high up-front costs of energy efficiency investments

### drawbacks:

- **Free-riding:** they often attract consumers who would have carried out the investments even without the incentive (e.g. high-income households) -> these measures must be targeted
- **Consumers that are the target audiences** (small to medium industries, and low-income households) do not take advantage of the schemes because they are unaware of them -> economic incentives need to be combined with public information and awareness campaigns
- **Subsidy schemes** may have a negative impact on the market by leading to an increase in the cost of equipment, as a result of manufacturers their prices in anticipation of the rebates that purchasers will be granted

# Information measures

## ▣ Information programs

soft measures

include: DSM/demand response programs and education, public outreach and awareness campaigns, training programs, certifications, smart metering, detailed billing

greater impact when combined with other policy instruments (regulatory or economic measures)

address a range of informational and behavioral barriers particularly acute in the residential sector

they also help to minimize the rebound effect and induce long-term behavioral change