



UNIVERSITY OF MINHO  
SCHOOL OF ENGINEERING  
CIVIL ENGINEERING DEPARTMENT



# Methodology for Cost Effective Energy and Carbon Emissions Optimized Building Renovation ECBCS Annex 56

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*International Energy Agency*  
**Energy Conservation In  
Buildings and Community  
Systems Programme**

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# IEA ECBCS Annex 56

## Background

- **Today's standards are mainly targeted to new buildings, providing less guidance on the renovation of existing buildings**
- **Today's standards do not respond effectively to the numerous technical, functional and economic constraints of this kind of buildings**
- **Today's standards are mainly targeted to energy efficiency measures that very often result in expensive processes and complex procedures, seldom accepted by users, owners or promoters.**





# IEA ECBCS Annex 56

## Background

- **Within the EU, each Member State must prepare, by 2015, renovation plans for existing buildings, with the nearly-zero energy goal**

**which means:**

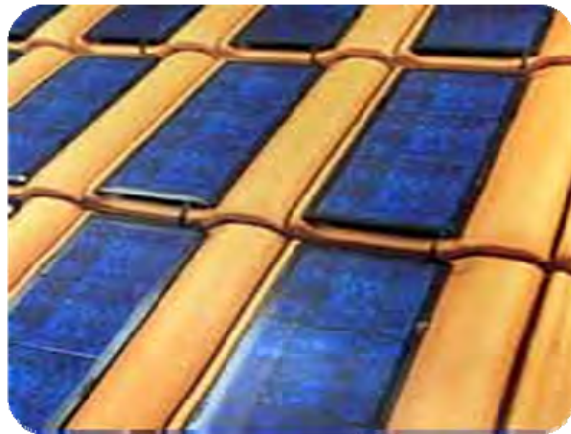
- **Goals must be set for energy consumption and carbon emissions for the existing building stock**
- **Cost effective renovation packages must be found**





**In existing buildings, the most cost-effective renovation solution is often a combination of energy efficiency measures and carbon emissions reduction measures.**

**So, it is relevant to investigate where is the balance point between these two types of measures in a cost/benefit perspective.**



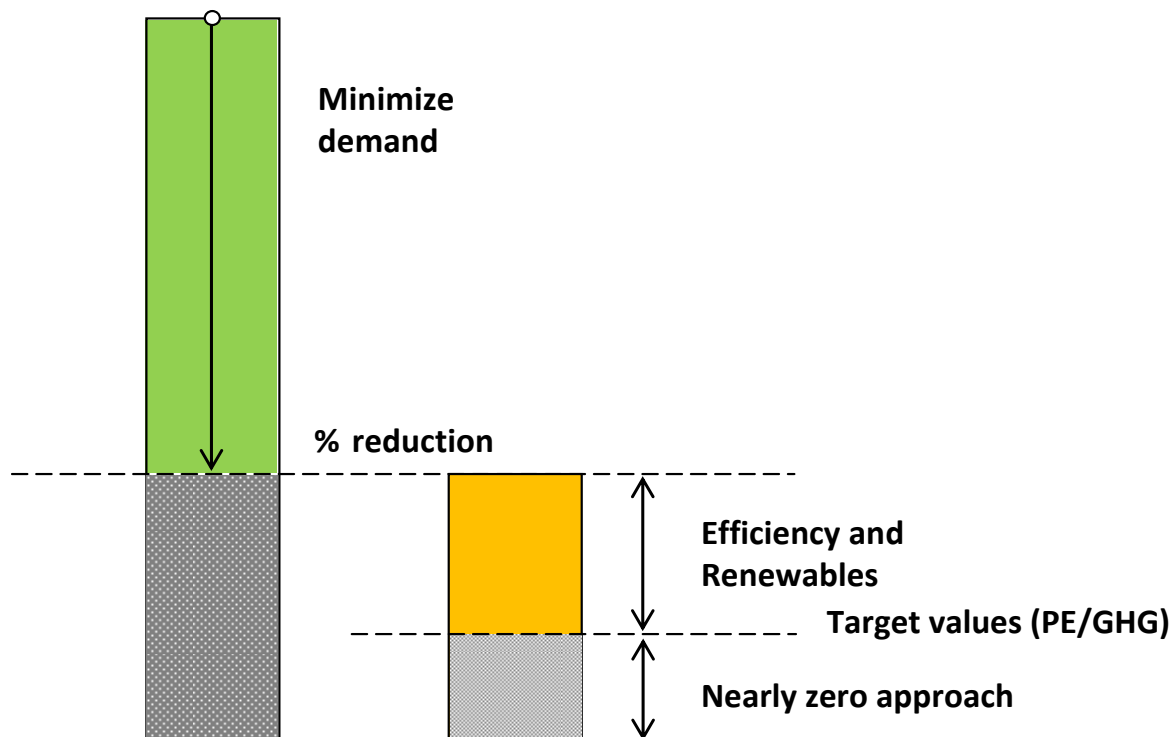
**Question?**

**How to achieve the best performance with minimal effort?**

## Annex 56 Objectives

**Develop a new methodology for a cost effective building renovation towards both the nearly zero energy and nearly zero emissions objective**

**Identify the optimal balance between the “minimization of demand” and “generation of renewable energy” measures in a cost/benefit perspective**



### Questions?

**How far is it possible to go with energy conservation and efficiency measures (initially often less expensive measures) and**

**From which point the carbon emissions reduction measures become more economical**



## Annex 56 Main Objectives

- **Define a methodology for the establishment of cost optimized targets for energy and carbon emissions in building renovation**
- **Clarify the relationship between the emission and the energy targets and their eventual hierarchy**
- **Determine cost effective combinations of energy efficiency measures and carbon emissions reduction measures**

**However, in this project we intend to have a broader approach, going beyond the cost effective reduction of carbon emissions and energy consumption and take into account, as much as possible, the overall added value achieved in a renovation process**



## Annex 56 Main Objectives

**Overall Added Value means identifying:**

- **Global quality improvement**
- **Economic impact of the intervention**
- **Operating cost reductions**
- **Resulting co-benefits (as much as possible)**

**It is also an objective, although in a voluntary basis, to take into account embodied energy and related emissions for building renovation materials and equipments since the better the performance of buildings the more relevant embodied energy use becomes .**



## Annex 56

### Scope

- **Residential buildings**  
Single-family houses and multiple-family buildings
- **Office buildings without complex HVAC systems**
  - if relevant and useful information can be extracted from them
  - used to prove the applicability of the developed methodology and tools to other buildings' categories besides residential buildings)







# Methodology for Cost Effective Energy and Carbon Emissions Optimized Building Renovation

## The Methodology :

- **Will allow taking into account country specific situations (like climate, electricity mix, conversion factors, national energy targets, etc.)**
- **Will allow prioritizing either nearly-zero emissions renovation (NZEmB) or nearly-zero energy renovation (NZE) , each with an additional energy or emission goal that has to be achieved at the same time**
- **In any situation there is a strong requirement to make sure that substantial energy reductions must be fostered whatever the priority chosen**

**The challenge will be to explore the tradeoffs between emissions reduction and energy reduction at the nearly zero border taking into account costs, energy use, emissions and, as far as possible, co-benefits**



## Co-Benefits

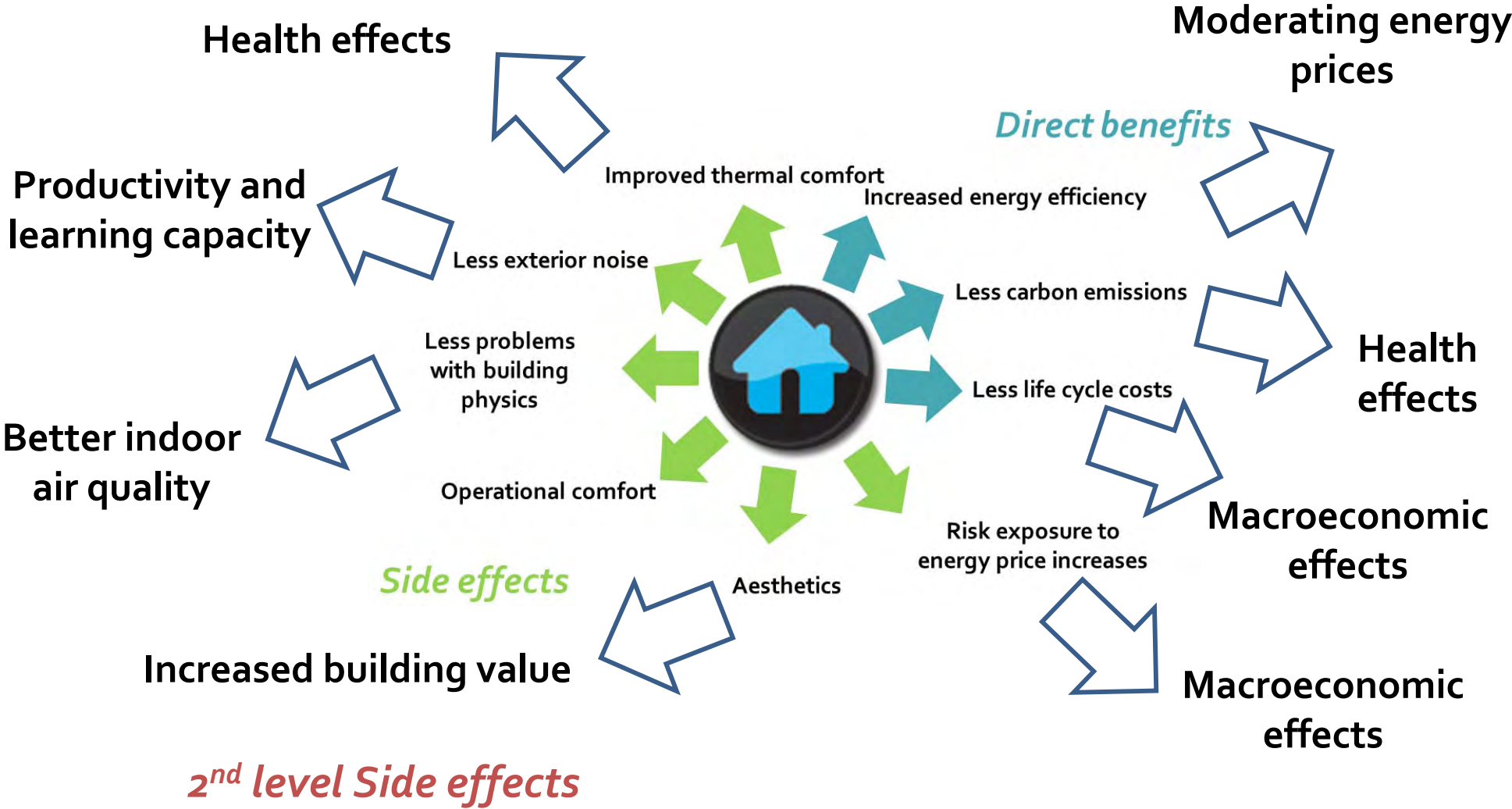
- **Integrate co-benefits in the methodology is one of the aims and one of the major challenges of this project**
- **Co-benefits – All benefits besides energy and energy cost savings and carbon emission reductions like comfort improvement (thermal, natural lighting, indoor air quality, acoustics, etc.), fewer problems related to building physics, fewer negative external effects of the building (air pollution) and increased value of the building**
- **Co-benefits can be as important as energy cost savings and, in certain circumstances can be the drivers for the renovation**

### Question:

- **How to find feasible methods to monetize, or at least partly quantify, added values in order to take them into account in cost-benefit analysis?**



# Co-Benefits







# Cost Effective Energy and Carbon Emissions Optimized Building Renovation

## Two Approaches

### Market Approach

Cost based, cost effective measures: range for measures between cost optimal and cost neutral, ranking/trade-off between energy or emissions reduction measures to be determined

### Normative Approach

Normatively (politically or environmentally) preset targets (primary energy or carbon emissions reduction), least cost measures to meet the targets

### Private cost perspective

Initial renovation cost

- Initial investment cost
- Replacement costs

Utilization costs building

- Energy costs
- Maintenance costs
- Operational costs

Co-benefits

### Social cost perspective

- Initial investment cost
- Replacement costs
- Energy costs
- Maintenance costs
- Operational costs
- **External costs or benefits**

### Preset energy targets

Preset with respect to

- Resource or environmental target
- Politically preset (depending on costs from market approach)

### Preset emission targets

Preset with respect to

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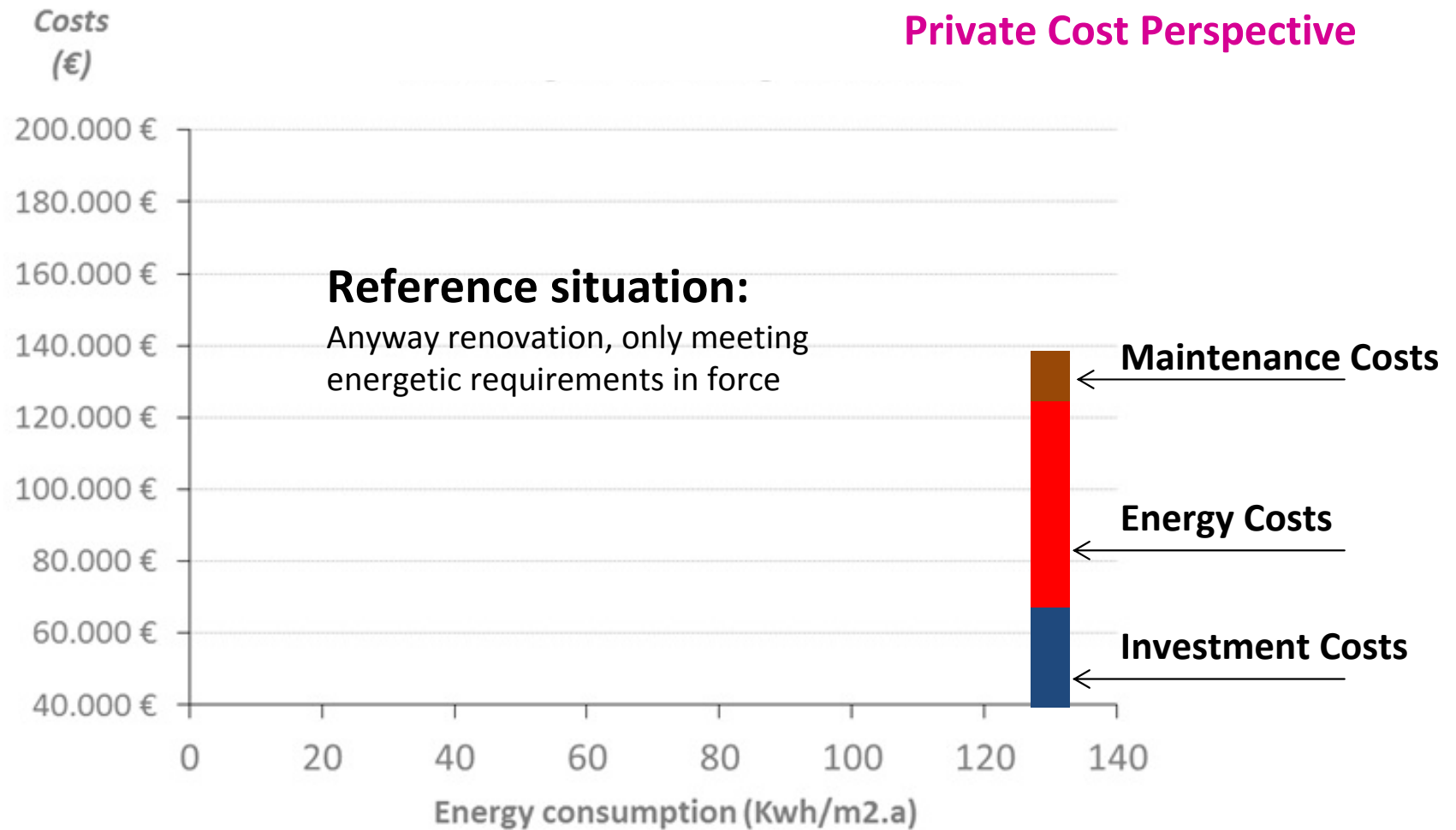
↑  
**Relevant for owners, investors, users**

↑  
**Relevant for policy makers**



# Methodology for Cost Effective Energy and Carbon Emissions Optimized Building Renovation

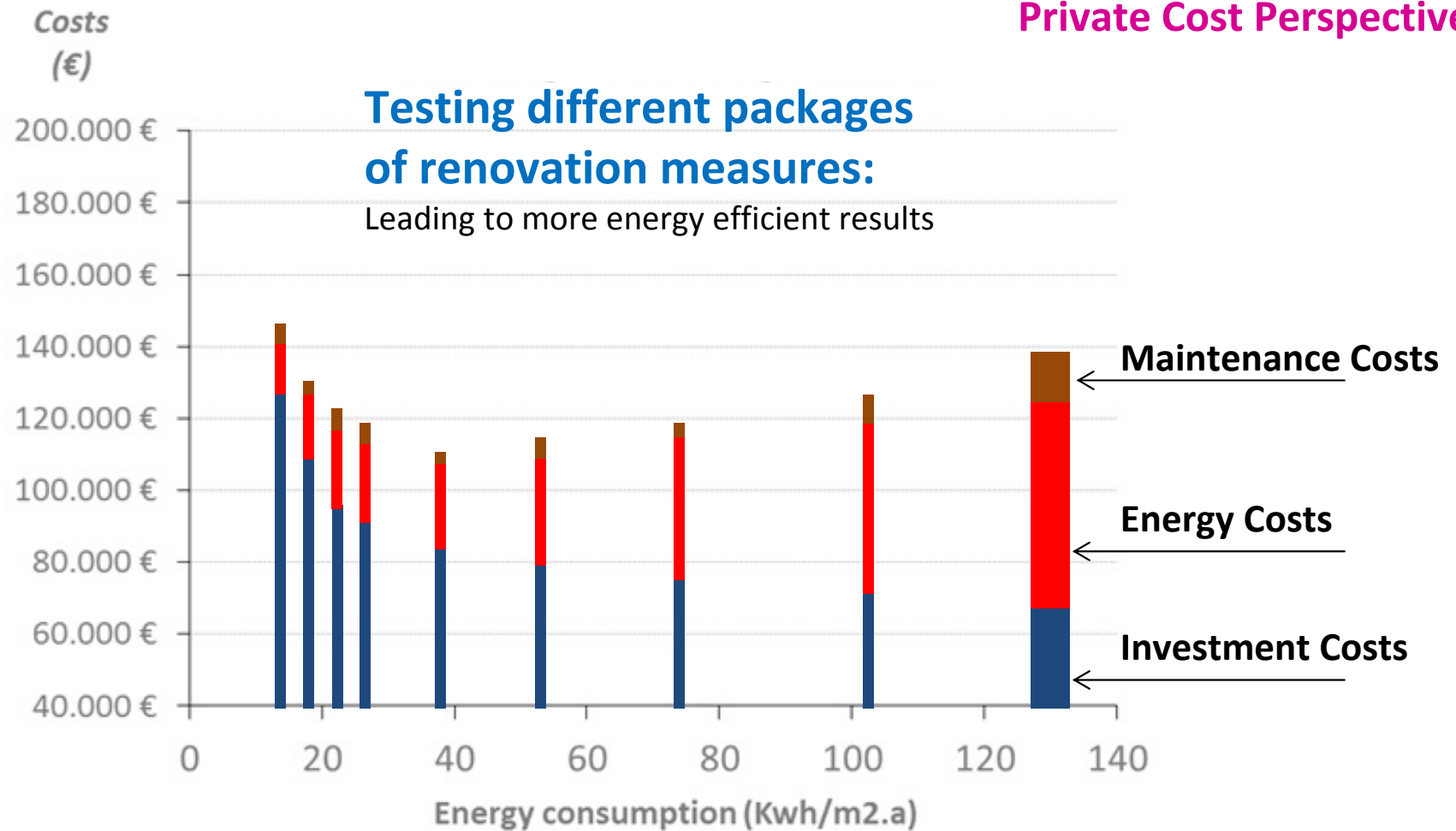
Market Approach  
Private Cost Perspective





# Methodology for Cost Effective Energy and Carbon Emissions Optimized Building Renovation

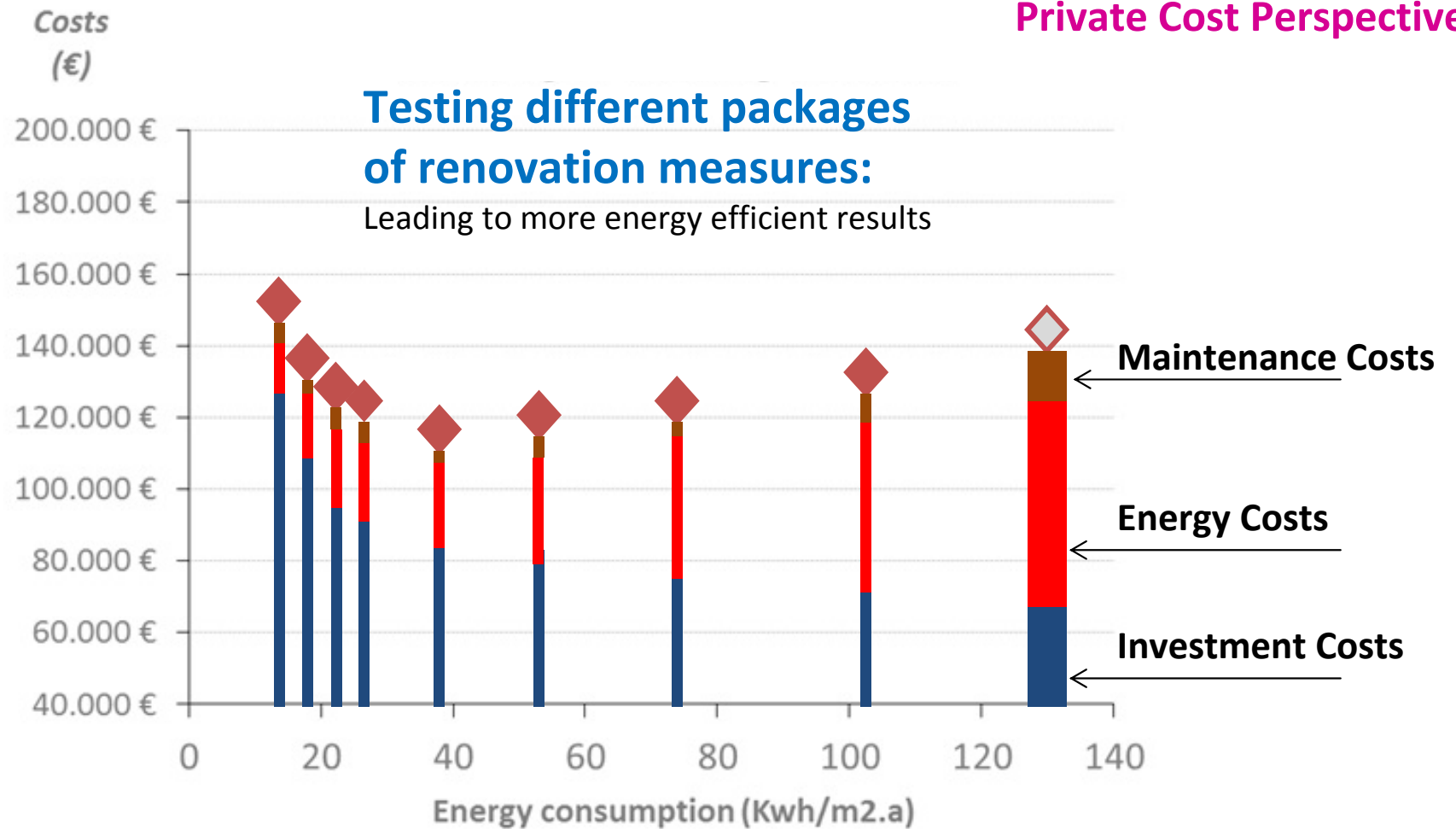
**Market Approach**  
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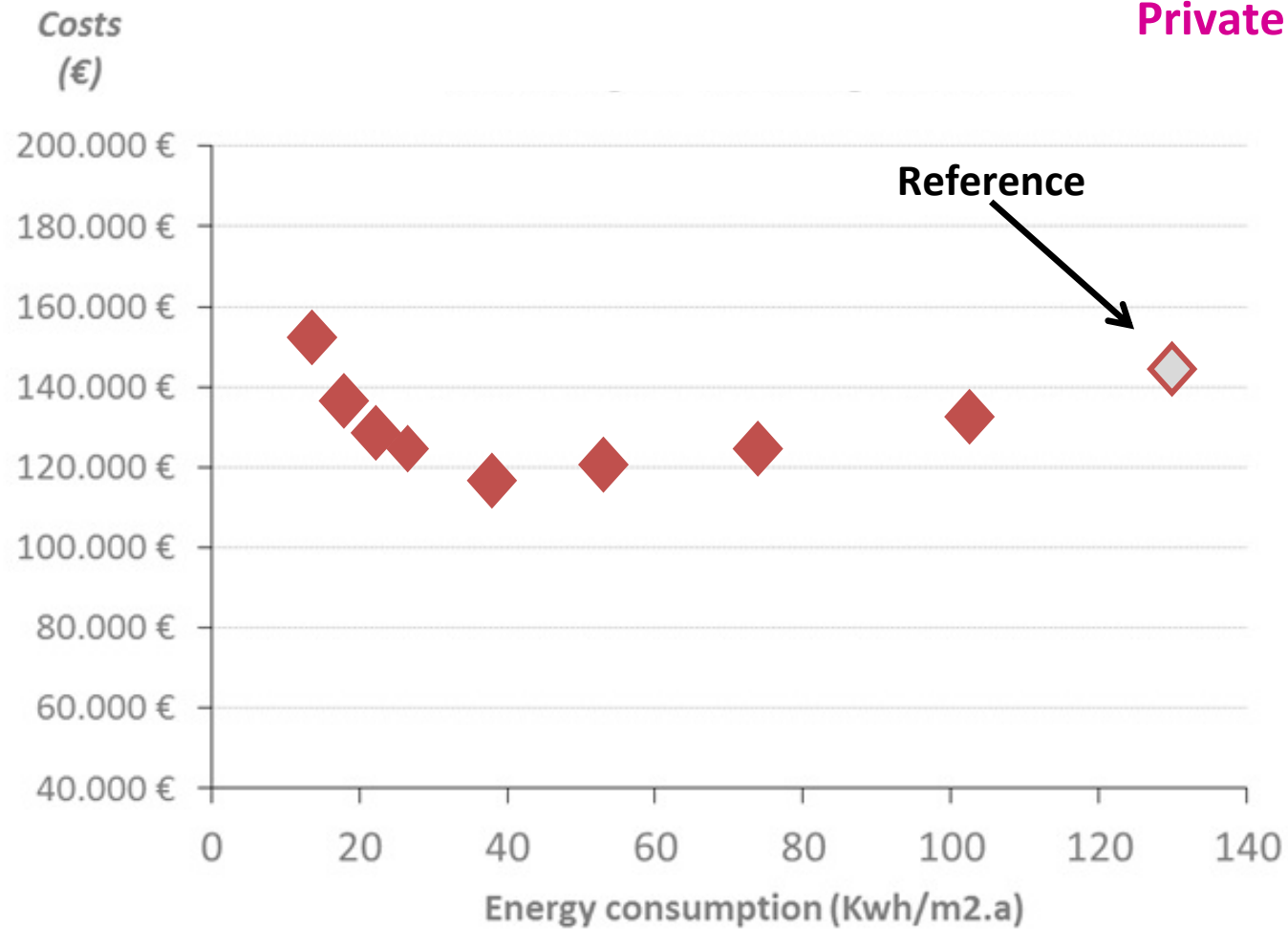






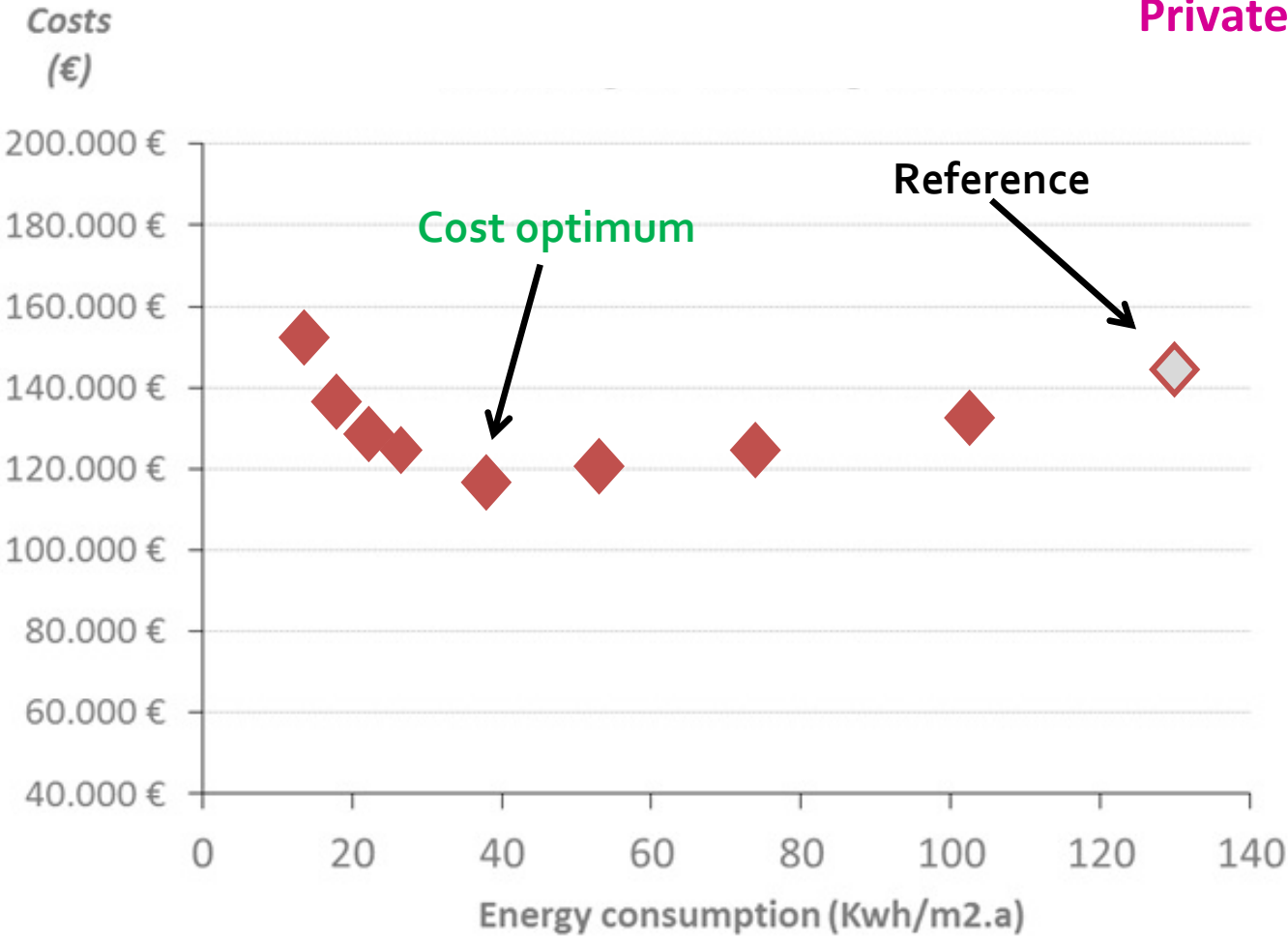
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Market Approach  
Private Cost Perspective



# Cost optimum and Cost-effectiveness

Market Approach  
Private Cost Perspective

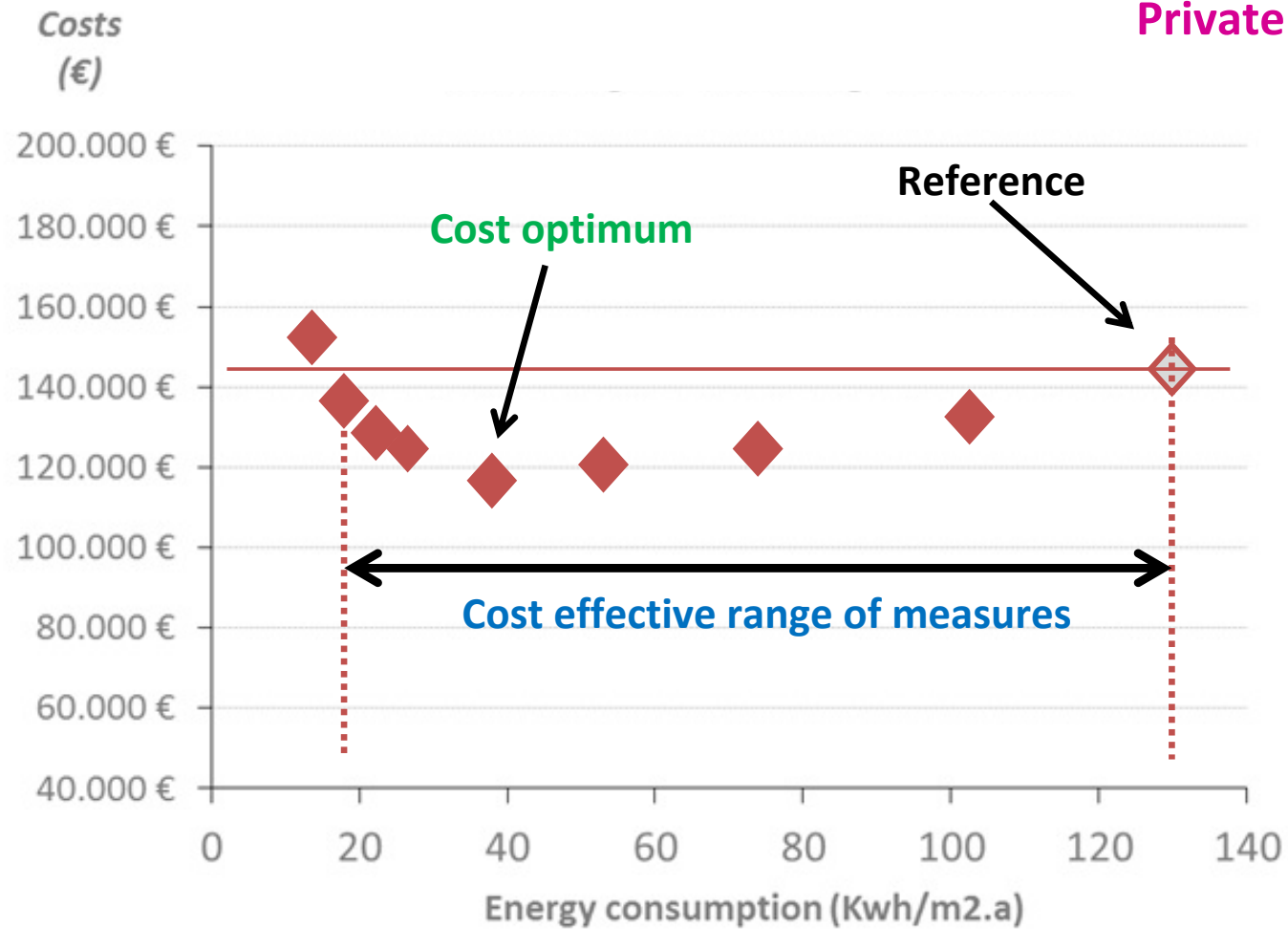


Global cost curve, starting from reference renovation solution towards less primary energy consumption or less carbon emissions

## Cost optimum and Cost-effectiveness

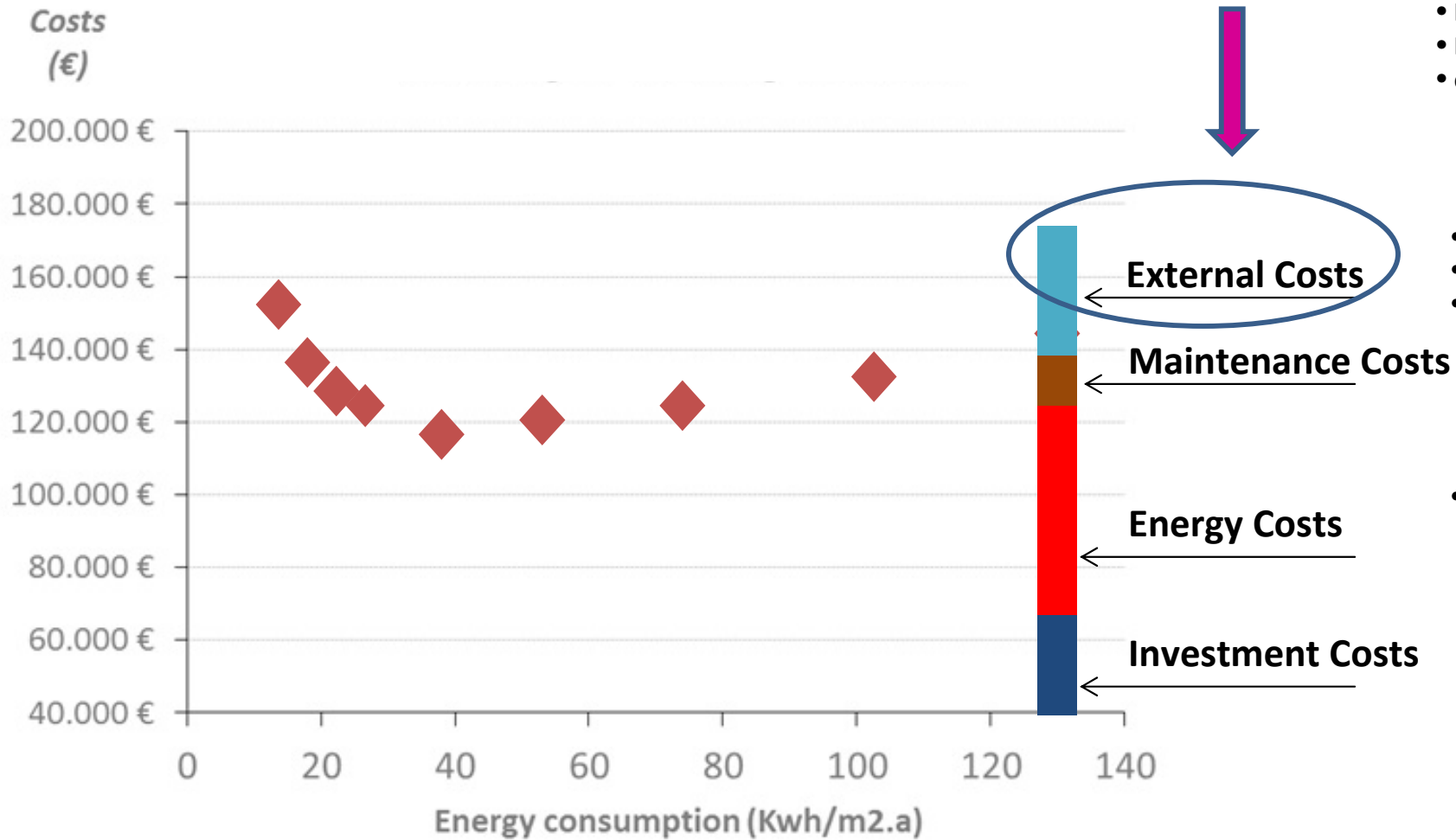
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# Cost optimum and Cost-effectiveness

## Market Approach Social Cost Perspective



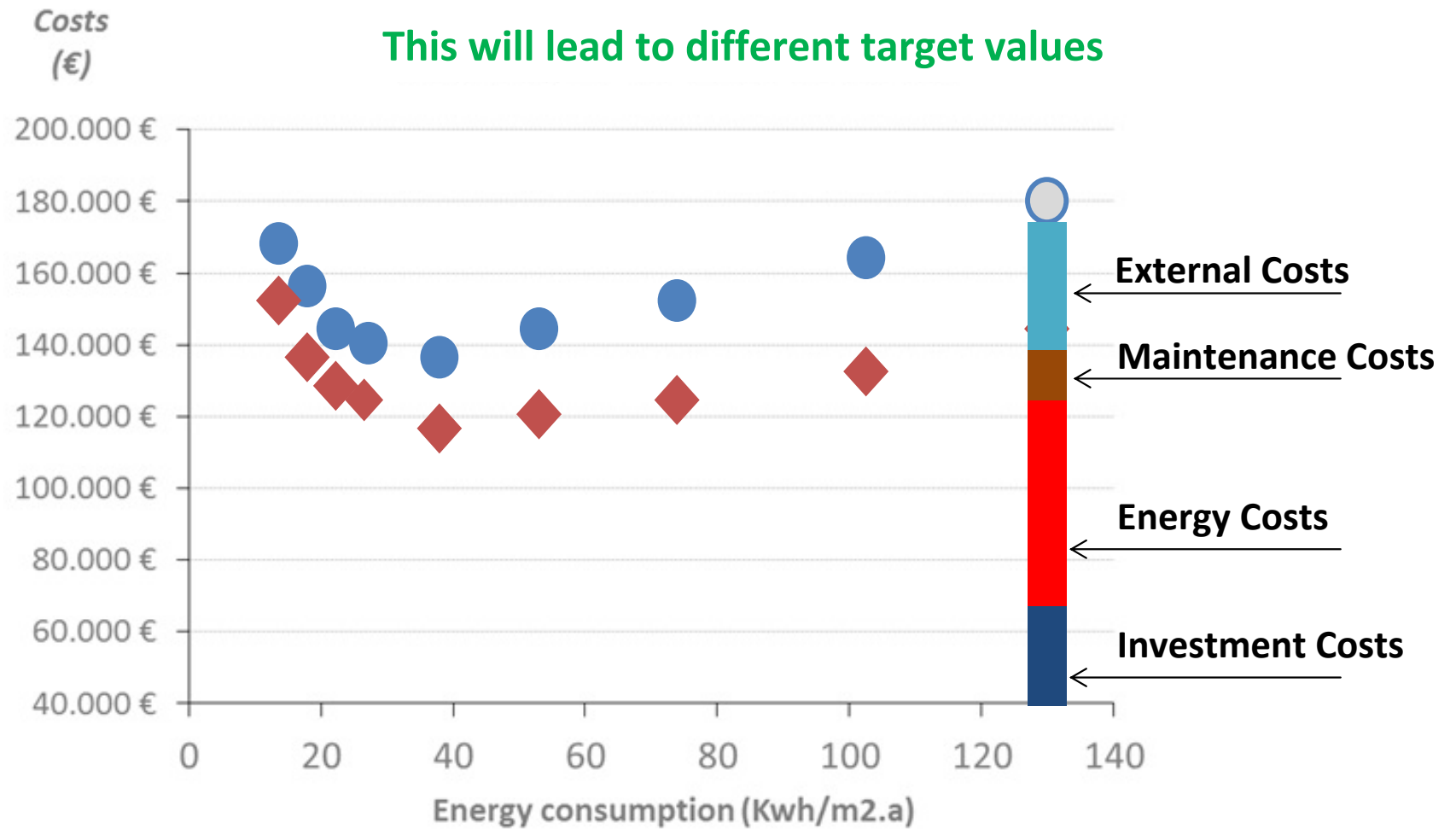
- Reduction of air pollution
- Increase use of renewables
- Reduce carbon emissions
- etc.

- Production of energy
- Transport of energy
- etc.

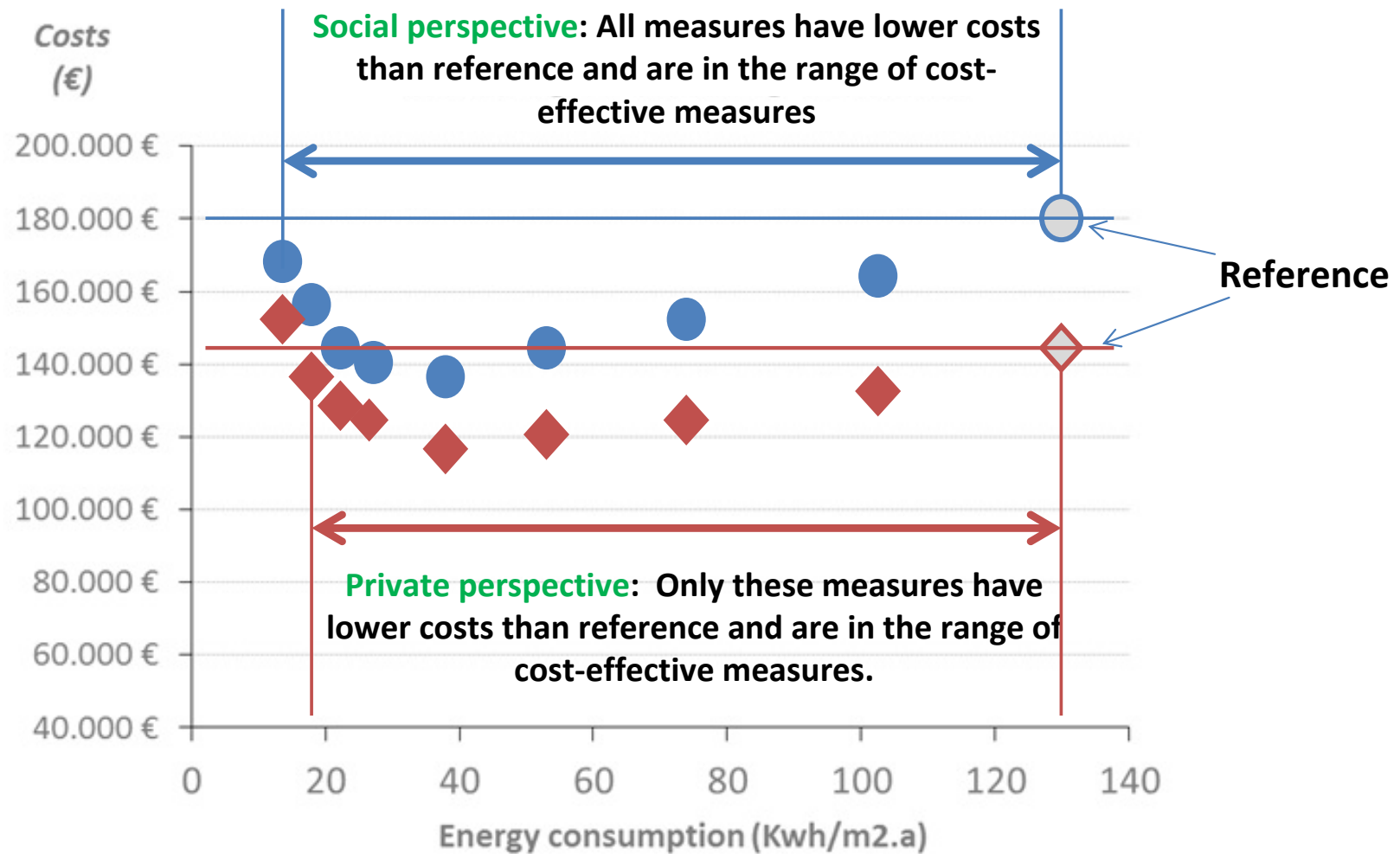
- This will lead to different target values

Global cost curve, starting from reference renovation solution towards less primary energy consumption or less carbon emissions

## Cost-effectiveness – social perspective and private perspective



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**Relevant for  
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***Thank you***

**COST EFFECTIVE ENERGY AND CARBON EMISSIONS OPTIMIZATION IN BUILDING  
RENOVATION**

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