Buildings for Sustainable Energy

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Green Islands Workshop

MIT Portugal

Buildings for Sustainable Energy

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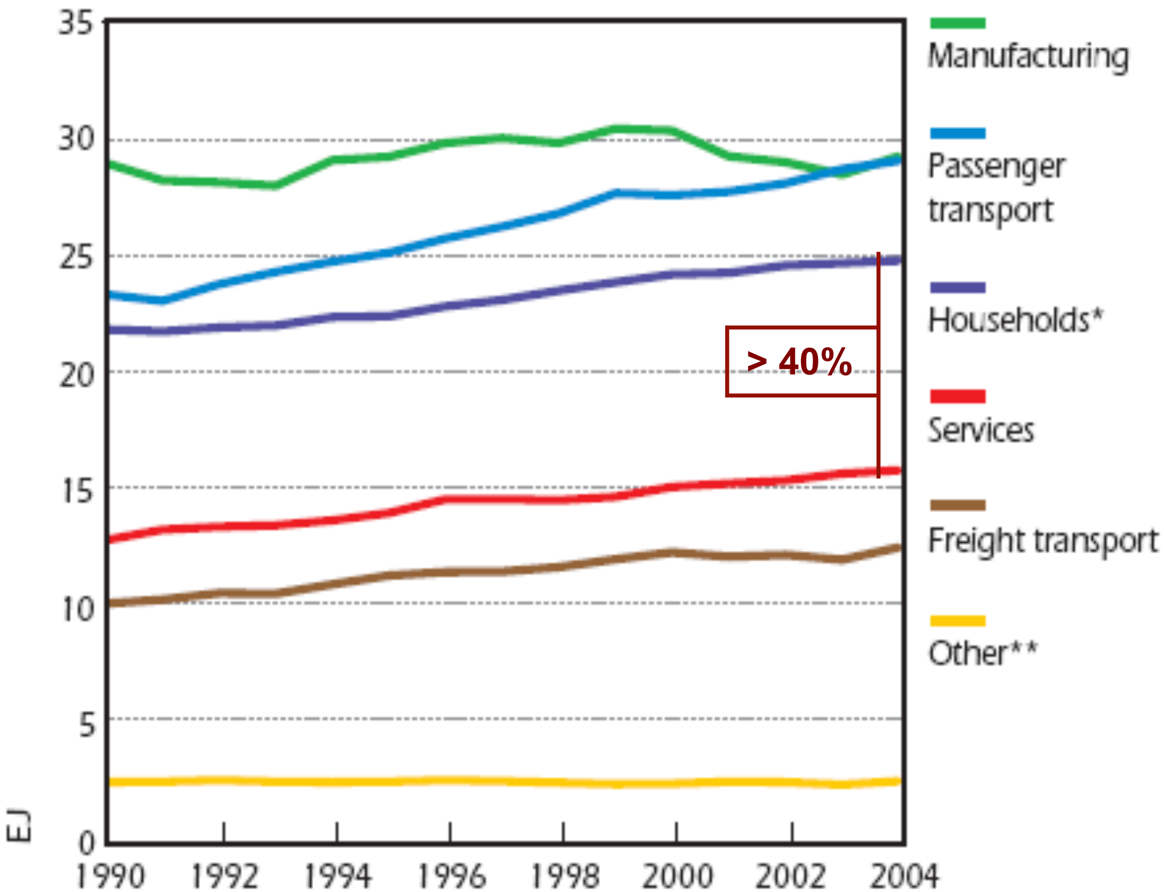
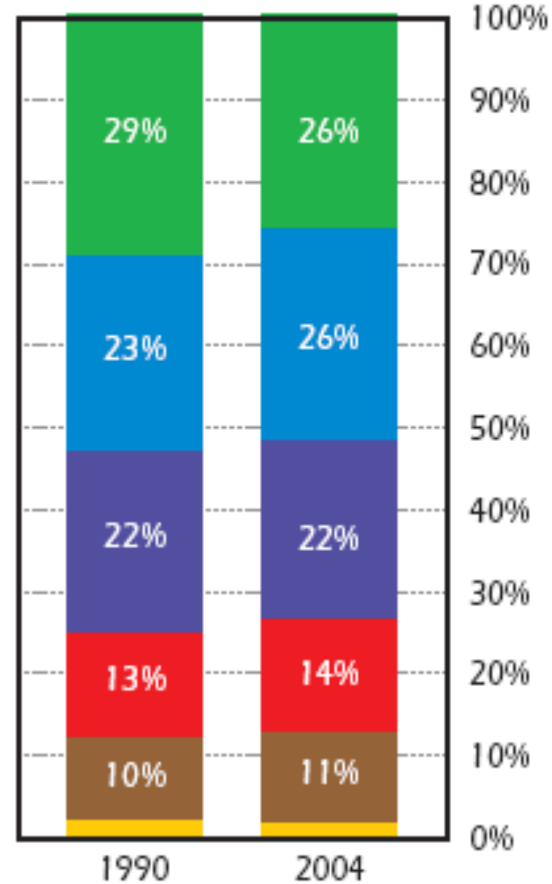
Buildings represent about 40% of the demand of primary energy and about 60% of the consumption of electricity in developed countries. It was therefore realized long ago that they are a key-piece of Energy Systems, and difference types of programs or regulations to drive them towards energy efficiency have been implemented, with the equilibrium point being determined by both cost-effectiveness considerations and by cultural (mis)perception of the issue. Recent time however added complexity to the topic, as the miniaturization and cost reduction of local energy "production" allow a second way to mitigate the impact of buildings in the energy systems. Furthermore, the "demand efficiency" and the ""local generation" paths can be combined in a multitude of ways, whose optimum is significantly context-dependent. The frontline of research in buildings has therefore moved from its physics to system analysis, first of the building as systems on their own, but also on how buildings interact with the "whole" energy system. Examples of this are the research on how much building energy load can be eliminated or be made flexible at cost-effective levels, as well as which doses of incentives, positive or negative, are effective to drive consumers to system-friendly options.

Buildings in the Energy System

Final Energy

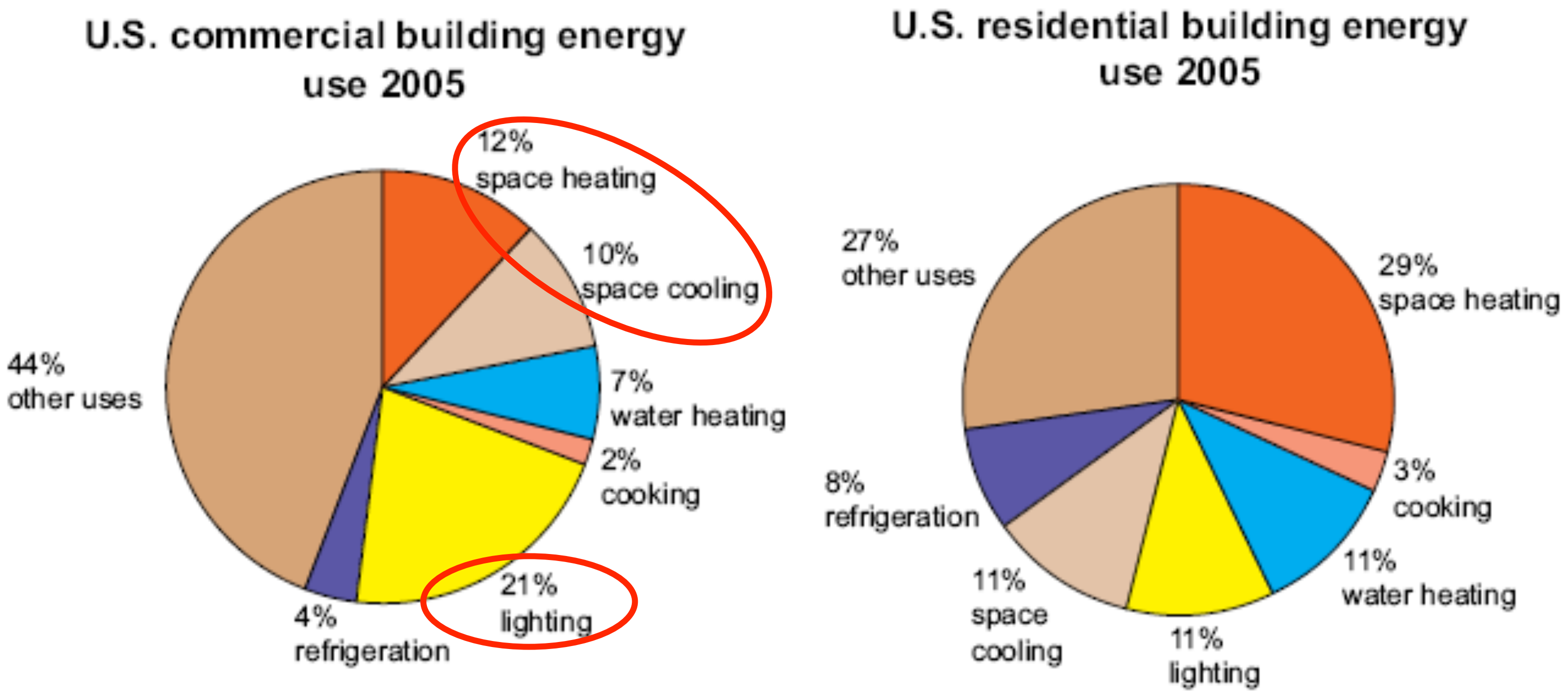


Total Final Energy Consumption in the non-residential building sector, IEA 14



Source: *European Commission, 2008 - Energy and Transport , Trends to 2030 – update 2007; IEA, 2007 - Energy Use in the New Millennium, Trends in IEA countries; Mckinsey & Company , 2007 - Curbing Global Energy Demand Growth: The Energy Productivity Opportunity*

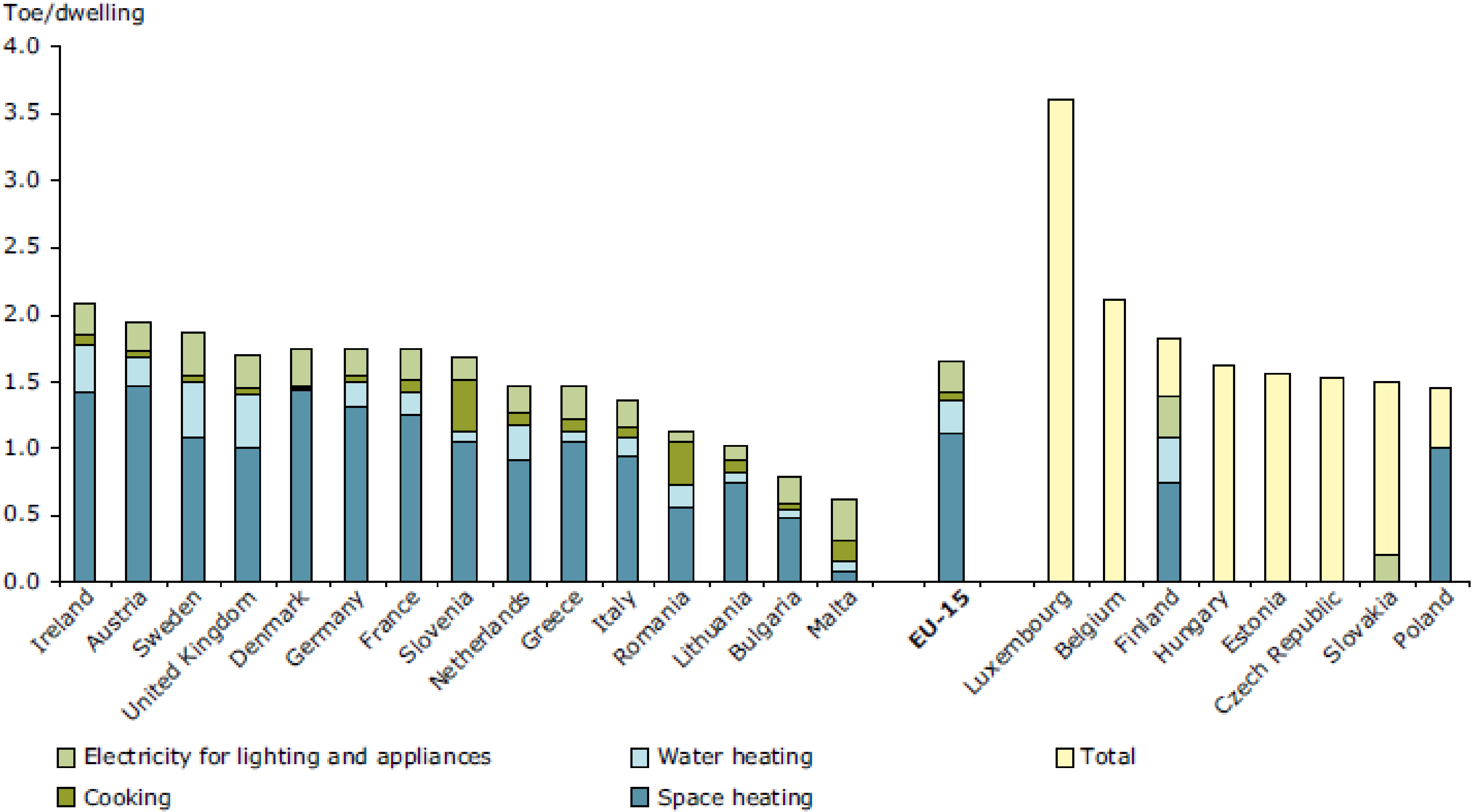
ENERGY USES (USA)



Comparison of the energy use (final energy) in commercial and residential sector (USA), in 2005. Source: M. Levine

ENERGY END-USES IN RESIDENTIAL BUILDINGS EU

Figure 6.2 Energy consumption by end use per dwelling, 2005



Note: A full breakdown of energy consumption by end-use is not available for the countries listed to the right of the EU-15 graph and hence only the total and available end-uses are shown.

Source: Odyssee.

Source: EEA 2008

Research related Heating, Cooling & time-agreggated energy balance

Research related to Heating and Cooling

TIME

- Thermal characterization of materials
- Requirements for Human Comfort
- Manual calculation of Heating and Cooling Loads
- Accounting for Thermal Inertia
- Thermal characterization of building components
- Human requirements for Indoor Air Quality / Ventilation
- Analysis and design of Natural Ventilation
- Analysis and design of Daylighting
- Dynamic Simulation
- Efficiency of HVAC equipments
- Building-integrated Renewables
- …

Policy Action

TIME

- Requirements for thermal insulation
- Requirements for Ventilation
- Thermal Performance

- Energy Performance [EPBD]
- Certification and Labelling
- Regular inspections and energy audits

- Promotion / Enforcement of profitable EE measures [incl/ existing buildings]
- PassivHouse
- Net-zero Energy Buildings

Recast EPBD (1): The 'Stick-Carrot-Tambourine' approach

1) The 'Stick': Performance Requirements

a) All new build "nearly-zero energy buildings" as of 2020 (public sector: 2018). Remaining energy need mainly covered by renewables

b) Minimum energy performance requirements for all existing buildings that undergo an energy relevant renovation

c) Level of minimum energy performance requirements for new buildings (until 2020) and renovations: Benchmarking to achieve cost-optimal levels

d) Requirement for min. energy performance levels for technical building systems when installed, replaced or upgraded

http://www.buildup.eu/system/files/content/ELSEBERGER%20Presentation%20From%20recast%20to%20reality%20CoR%20EUSEW%2023032010.pdf

Recast EPBD (2):
The 'Stick-Carrot-Tambourine' approach

2) <u>The 'Carrot': Financing</u>

a) Stimulating financing mechanisms for energy efficiency investments

b) Assessment of appropriateness & best practices of fin. instruments

3) <u>The 'Tambourine': Information</u>

a) Strengthening the <u>role and the quality of energy performance certificates</u> – i.a. by quality checks & use of performance indicator in all advertisements

b) Strengthening the <u>role and the quality</u> of Heating and AC system <u>inspections</u>

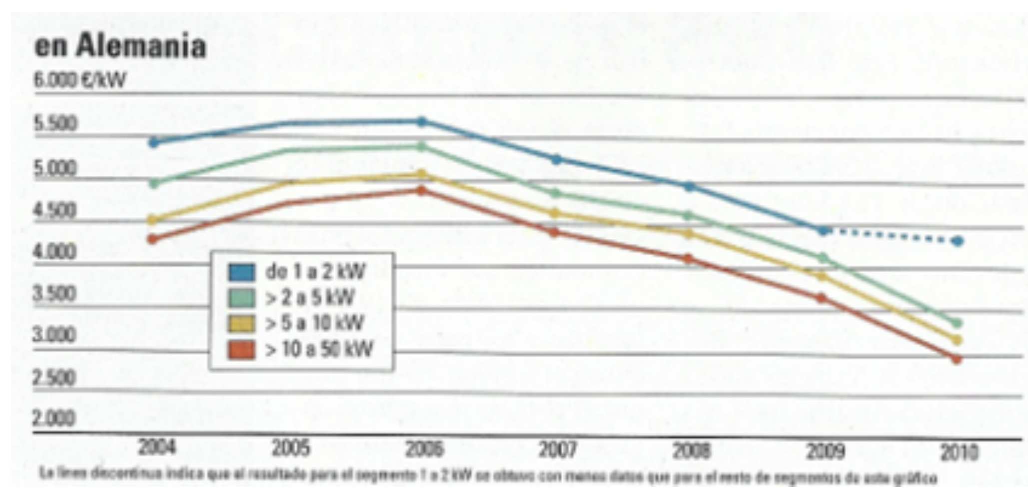
c) <u>Display</u> of EP Certificates in public buildings

http://www.buildup.eu/system/files/content/ELSEBERGER%20Presentation%20From%20recast%20to%20reality%20CoR%20EUSEW%2023032010.pdf

Renewable E. Technologies for Building Integration

- Solar Thermal
- Photovoltaics
- Wind Turbines
- Micro-CHP
- ...

- Maturation of Technology
- Increasing energy prices change context



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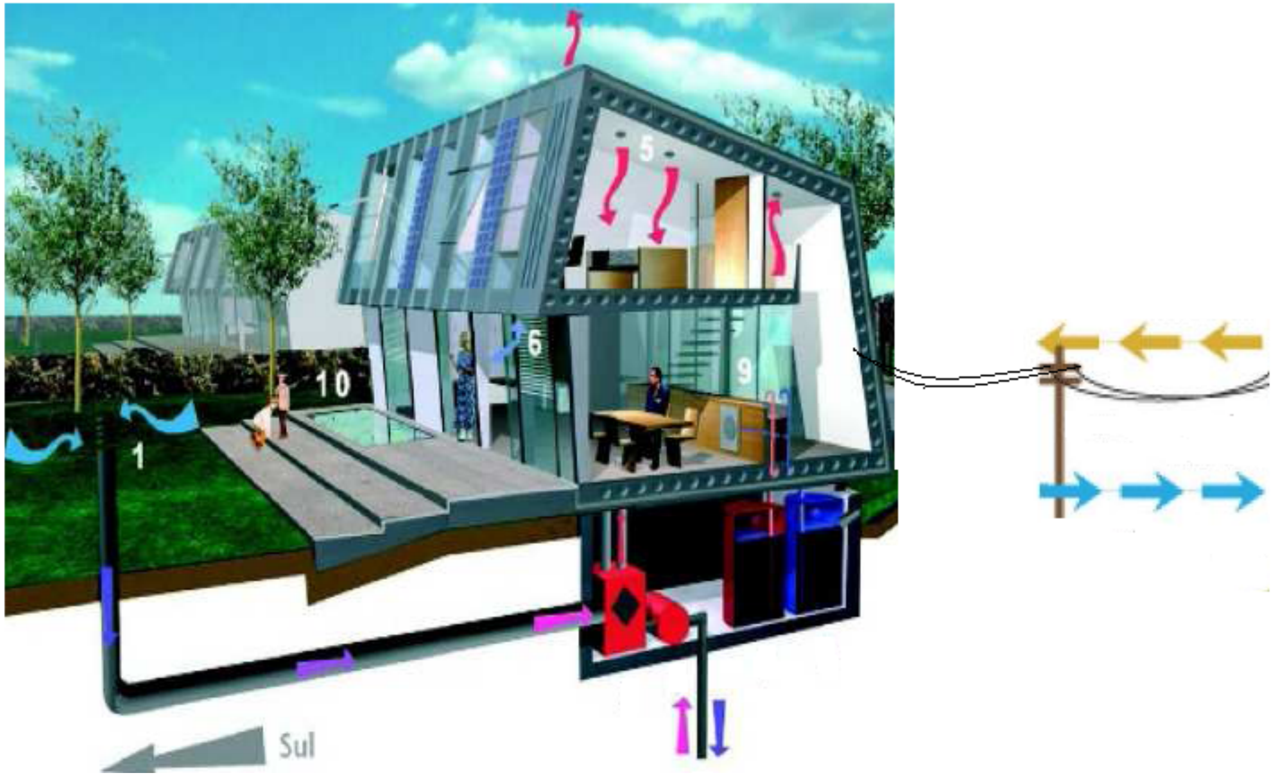
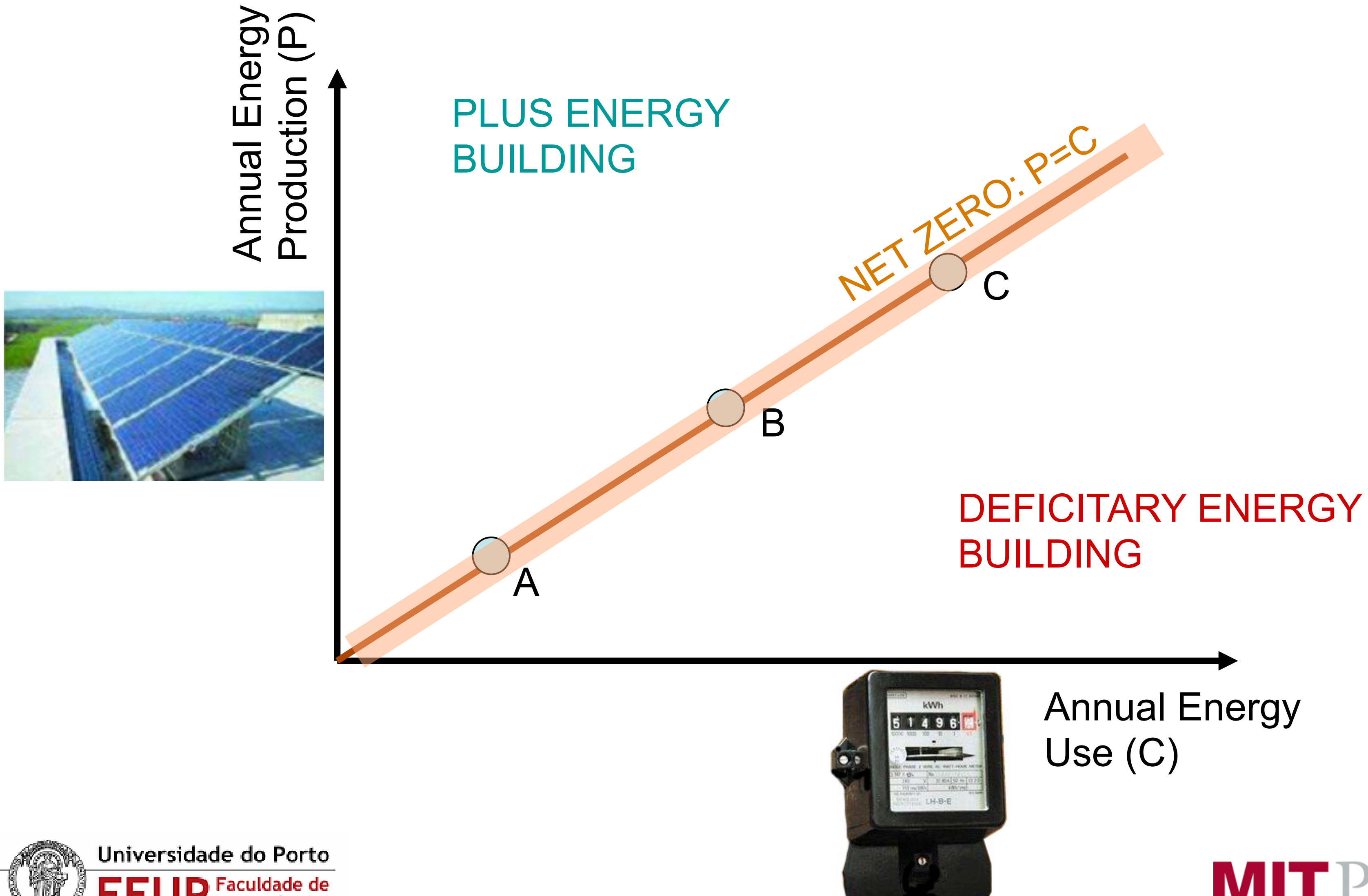
Net-Zero Energy Buildings

- A Net-Zero Energy Building (NZEB) is a building that includes microgeneration and is bidirectionally connected to the grid so that it produces as much energy as it uses when measured on site on a annual basis

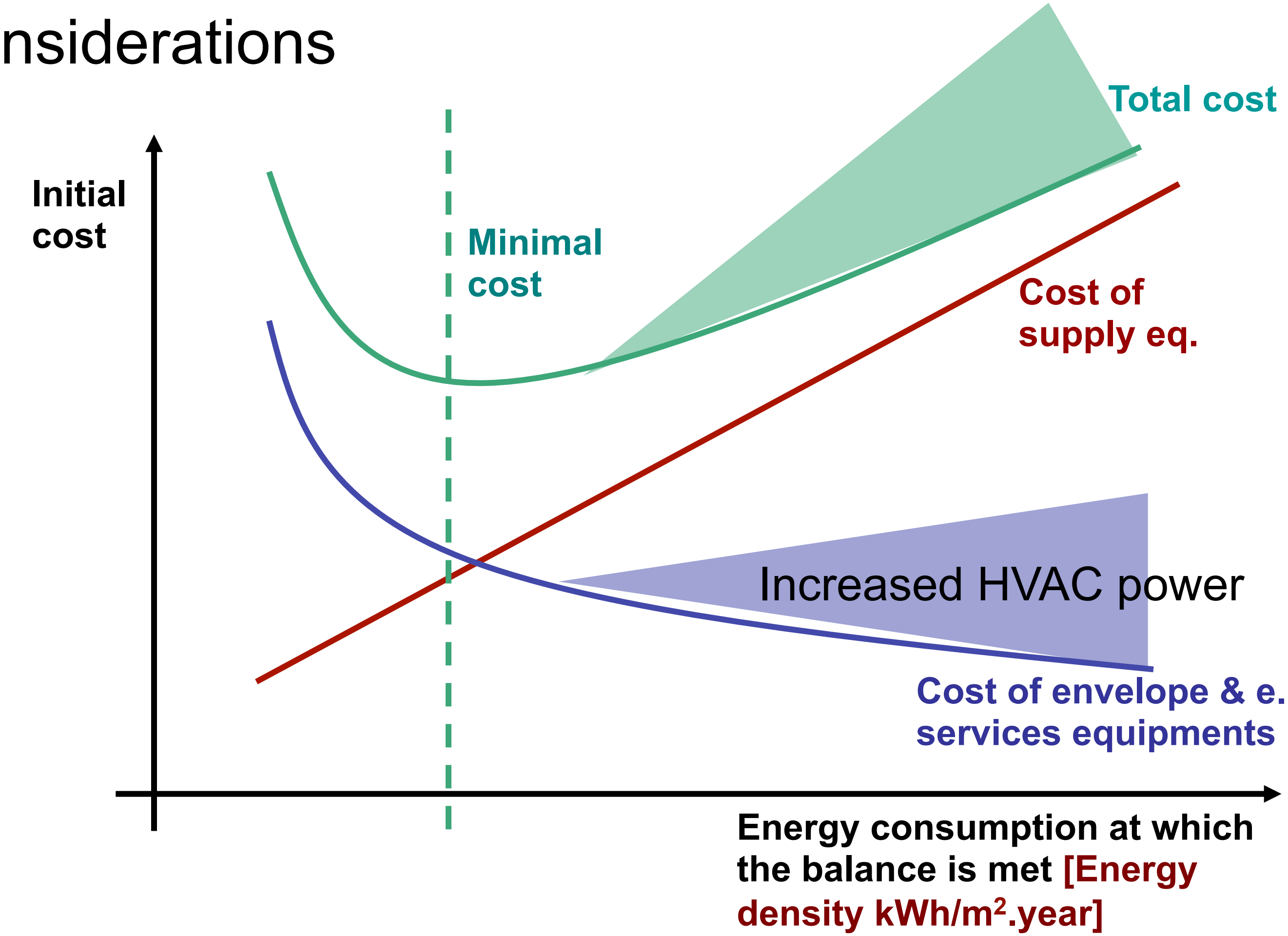


- It is proven that they can be built !
- So what now ?

Net Zero Energy Building Concept

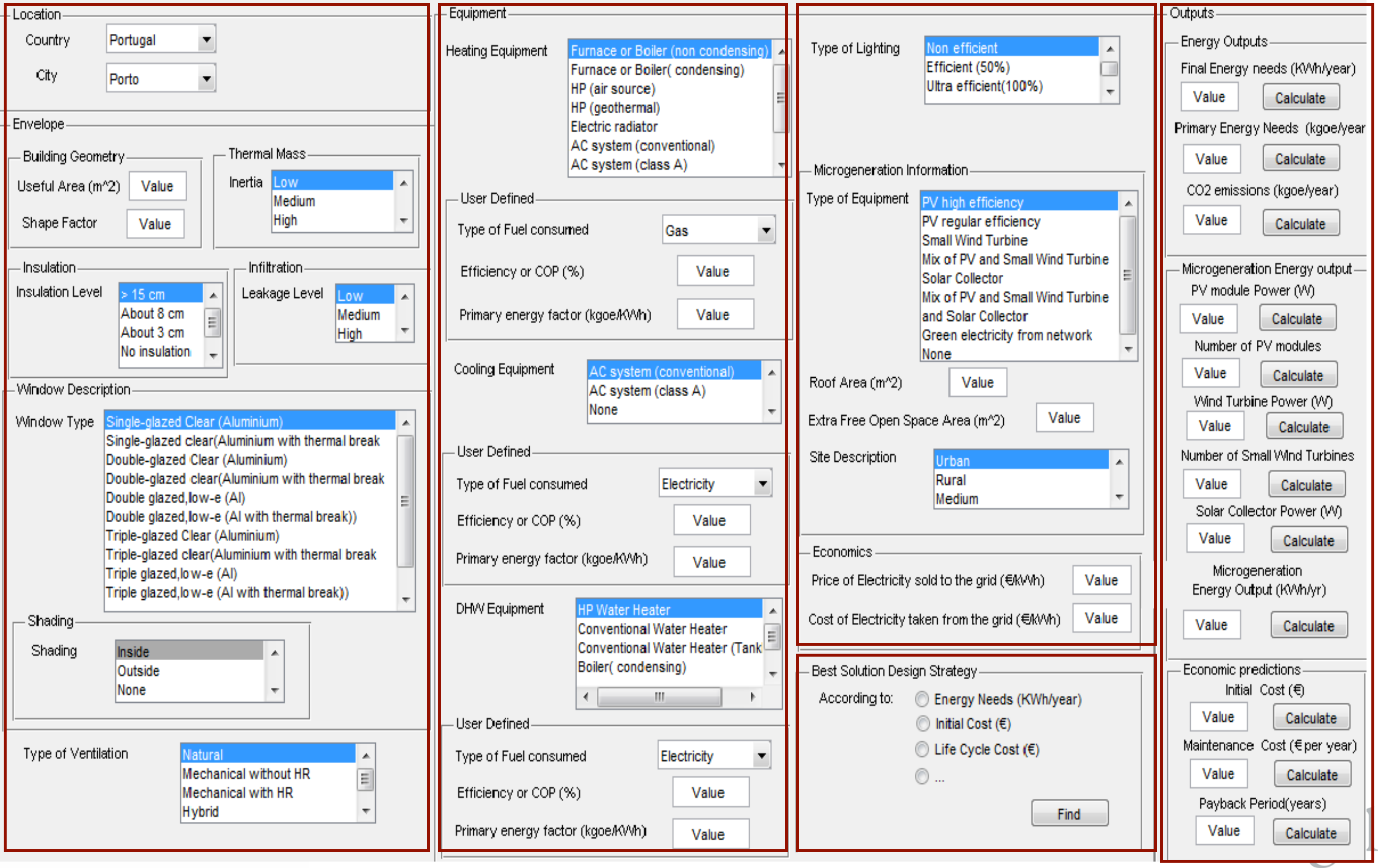


Cost considerations



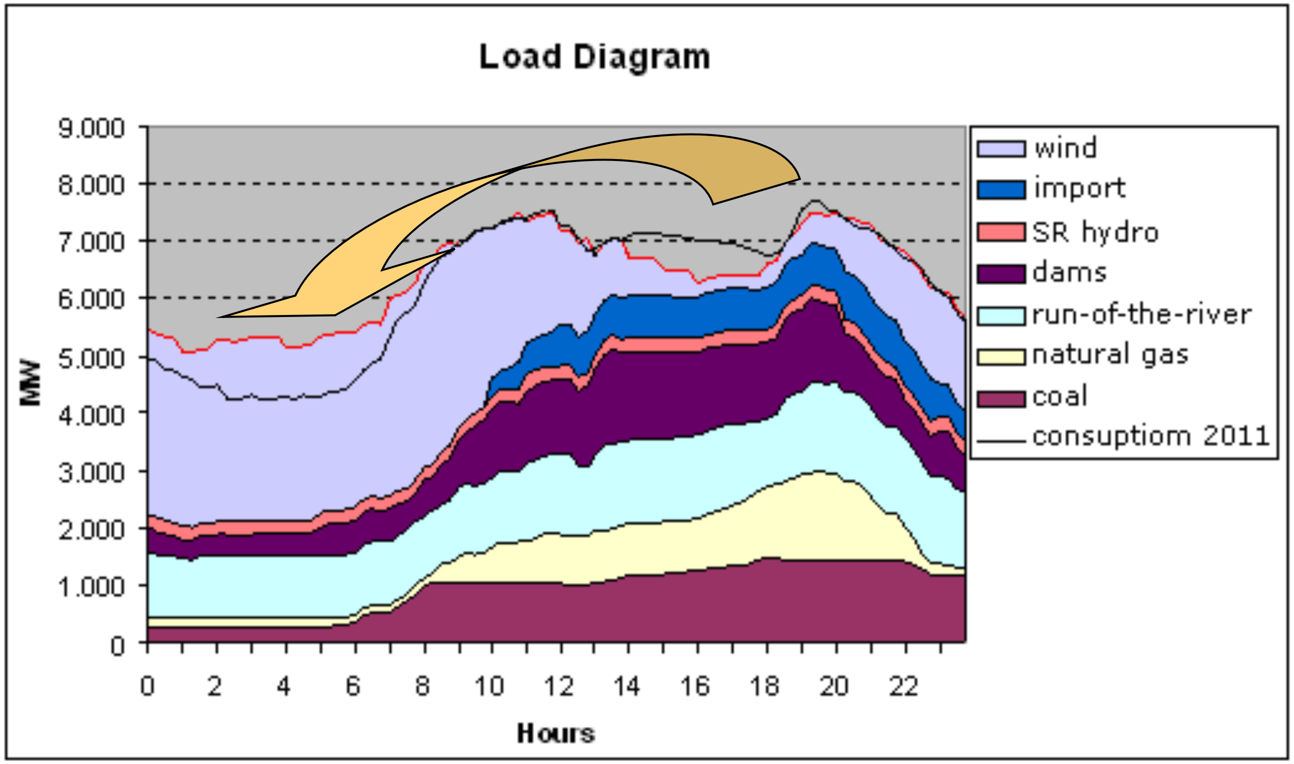
The point at which the minimal cost is met must depend significantly on the local climate – No "one size fits all" solution

DesignTool Interface



Helping the Electric Grid

Limitting [Deferring ?] the investments in generation and transmission infrasctructure

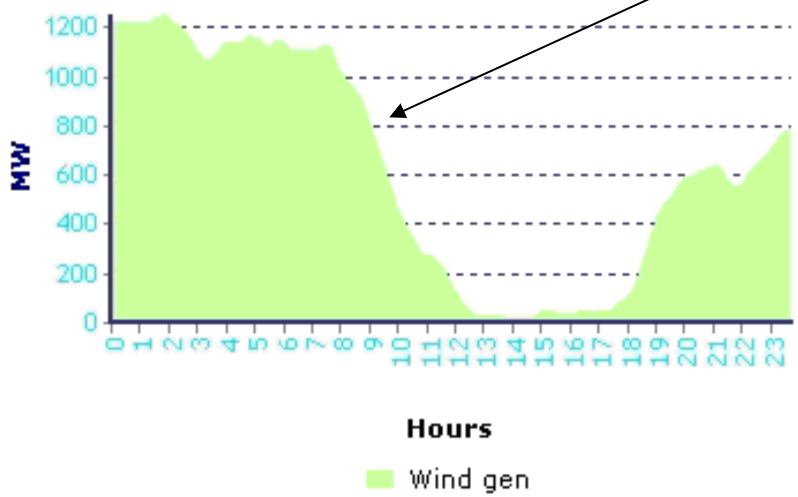


- **Which loads could be shifted;**
- **Which technical strategies of control:**
- **How to avoid simultaneous reconnects (new peaks)**
- **Which levels of incentives necessary**

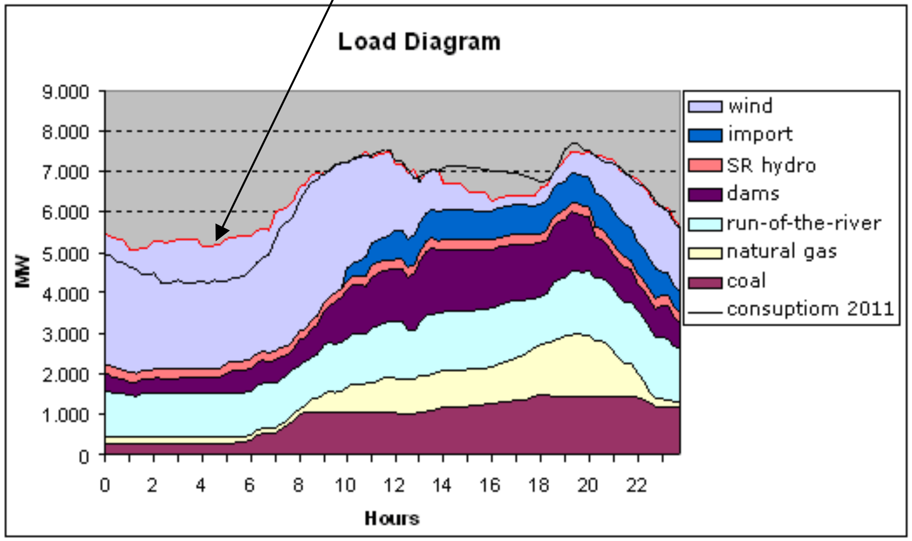
Enabling the integration of more Renewable E.

- **Large scale wind generation deployment requires either central storage management or active load management (increasing consumption):**
  - **To increase load**
  - **To deal with reserves management**

Storage or consumption is needed



Wind Generation of 14 th February 2007
Source: REN (Portuguese TSO); http://ww.ren.pt



Prospective generation allocation in a winter windy wet day (2011)

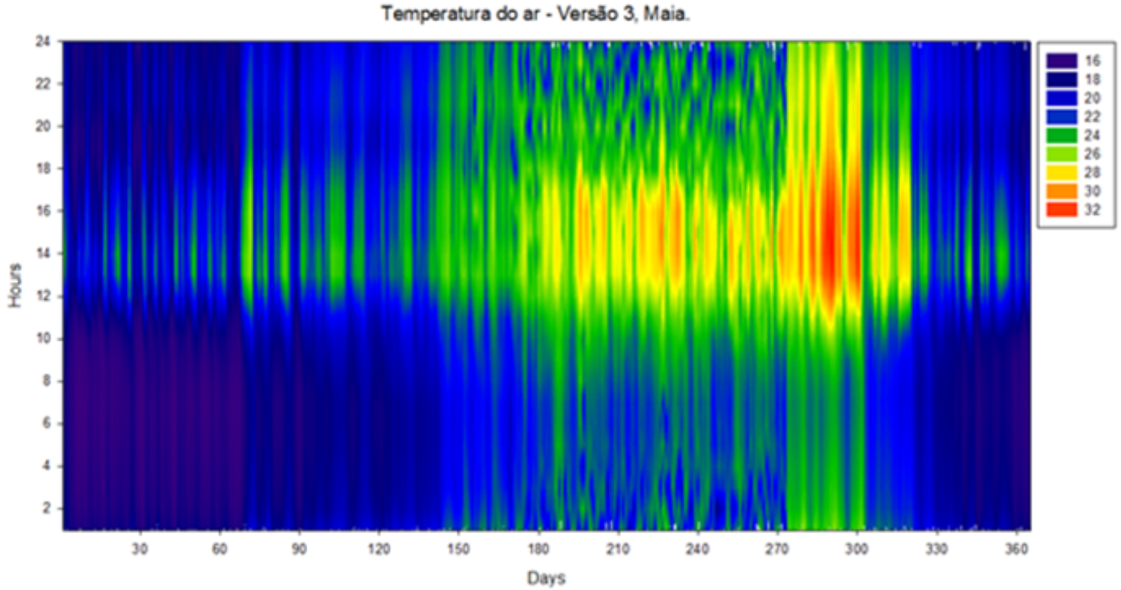
In a wider perspective: to adapt the load to the supply interests [technical or economic or both]

On-site vs. Off-site offset for NZEBs

Technology	Scenario	Levelized Cost* (€/kWh)
Micro PV	1, 2, 3	0.32
Micro Wind	4, 5, 6	0.21
Macro PV	7	0.20
Macro Wind (1500h)	8	0.07
Macro Wind (2500h)	9	0.04

Social / Behavioral issues

Resilience to Fuel Poverty



ÍPSILON | GUIA DO LAZER | CINECARTAZ | INIMIGO PÚBLICO

Público 20

Peter Cook
"Portugal merece mais do que uma arquitectura cool"

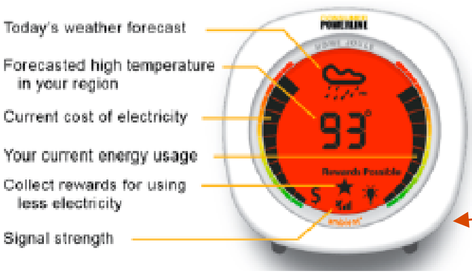
Portugal é um dos países da UE onde mais se morre de frio

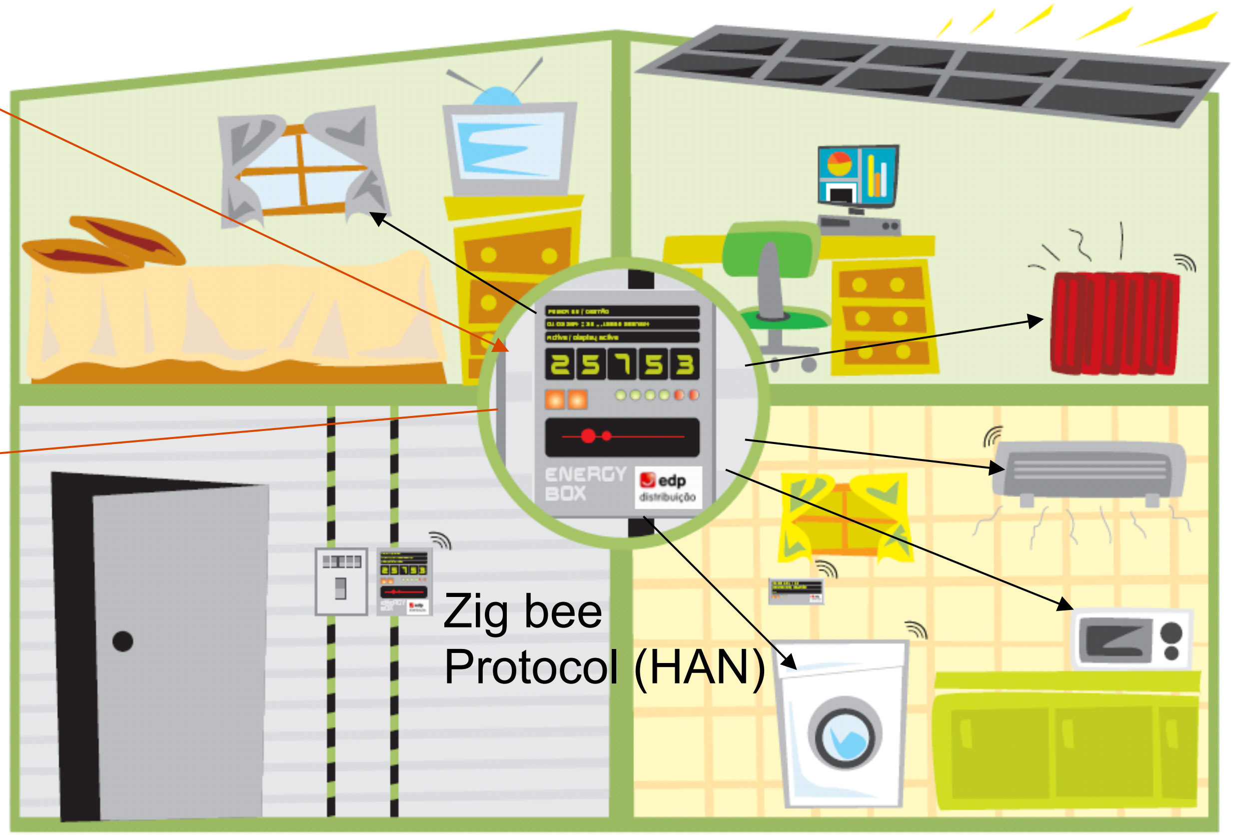
15.02.2010 - 12:53 Por Lusa

A falta de condições de isolamento das habitações poderá ter estado ontem na origem da morte de quatro idosos em Lisboa (Adriano Miranda (arquivo))

Behaviors & attitudes incl/ Smartmetering

Consumer energy use awareness will increase





Slide by Prof. Peças Lopes / INESCPorto

- Which information are users sentitive to ?
- Which incentives necessary to achieve a behavioral reaction ?

Dynamizing the Local Economy

Role in Whole-Energy-System transformation

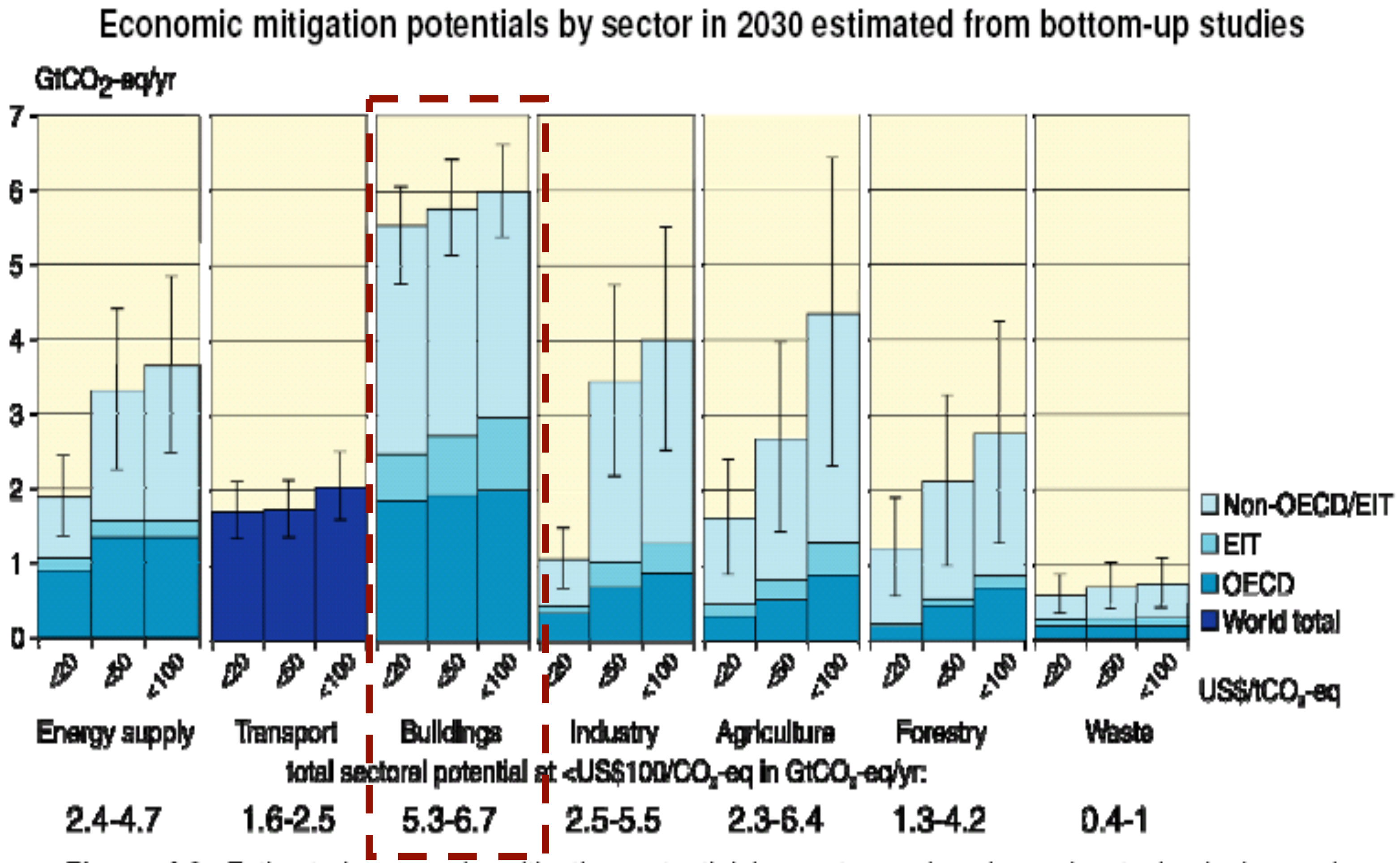


Figure 4.2. Estimated economic mitigation potential by sector and region using technologies and practices expected to be available in 2030. The potentials do not include non-technical options such as lifestyle changes. {WGIII Figure SPM.6}

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Thank You