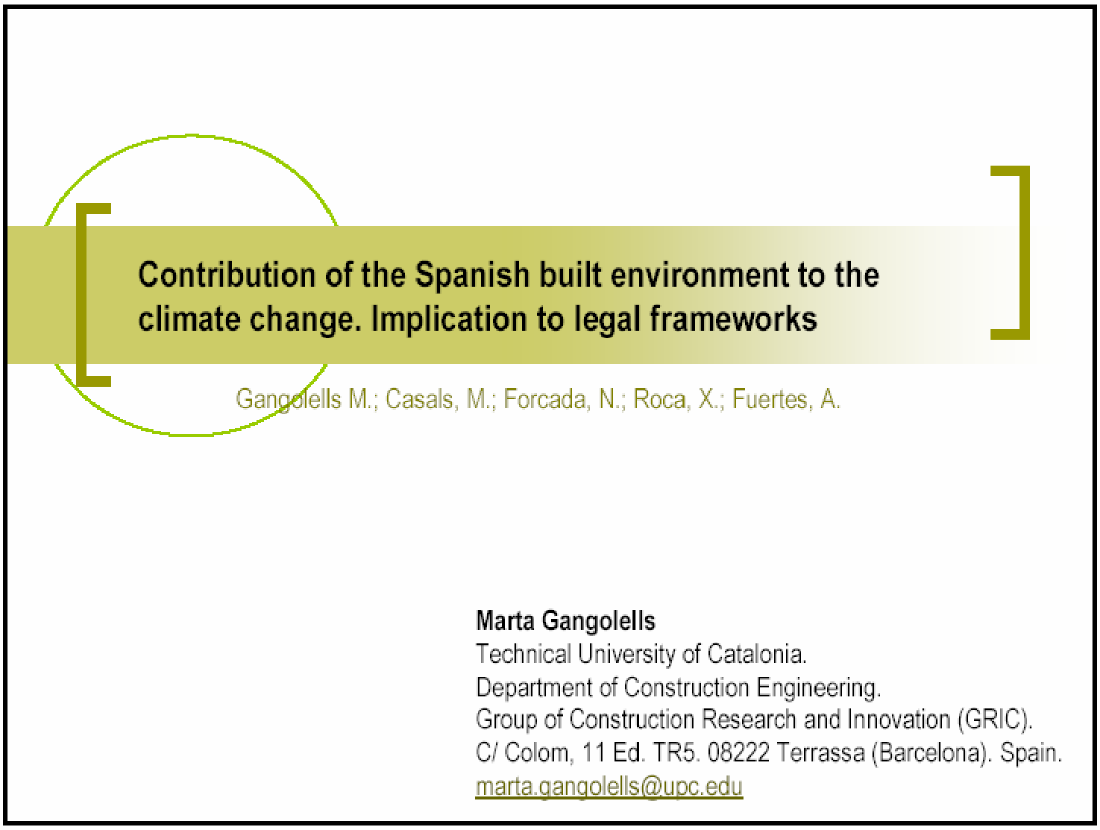
Contribution of the Spanish built environment to the climate change. Implication to legal frameworks
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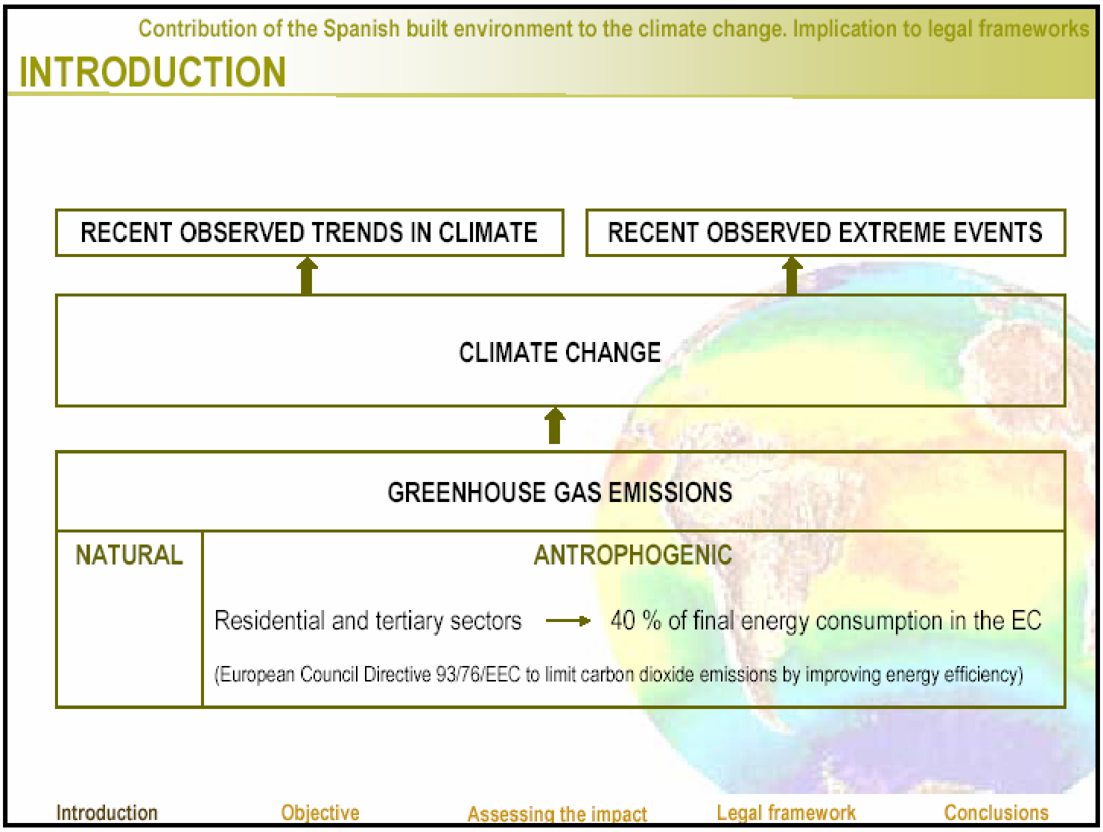
Contribution of the Spanish built environment to the climate change. Implication to legal frameworks
INTRODUCTION
RECENT OBSERVED TRENDS IN CLIMATE
RECENT OBSERVED EXTREME EVENTS
CLIMATE CHANGE
GREENHOUSE GAS EMISSIONS
NATURAL
ANTROPHOGENIC
Residential and tertiary sectors → 40 % of final energy consumption in the EC
(European Council Directive 93/76/EEC to limit carbon dioxide emissions by improving energy efficiency)
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OBJECTIVE

To assess the impact of the Spanish built environment on climate change and the implication to legal frameworks

- Assessing the impact of the Spanish built environment on climate change
- Effectiveness gaps on the assessment of the impact of the Spanish built environment on climate change
- Legal framework
- Effectiveness gaps on current legal framework
- Conclusions and recommendations for policymakers

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ASSESSING THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

EUROPEAN UNION **Buildings sector (2004)**

Final energy consumption

471.7 Mtoe
(41.3% of the total EU-25 final energy use)

Residential buildings	172.1 Mtoe	36.46%
Tertiary sector	299.7 Mtoe	63.53%

Greenhouse gas emissions

732 million tonnes of CO_2
(19.0% of the total EU-25 dioxide emissions)

Residential buildings	470 million tn	64.20%
Tertiary sector	262 million tn	35.80%

(European Commission - Energy and transport in figures 2006)

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ASSESSING THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

SPAIN

Buildings sector

Final energy consumption

25.3 Mtoe (year 2004)
(27 % of the total Spanish final energy use)

(European Commission - Energy and transport in figures 2006)

Residential buildings	14.4 Mtoe	56.91%
Tertiary sector	10.9 Mtoe	43.08%

14.5 Mtoe (year 2000)
(16 % of the total Spanish final energy use)

(Spanish Ministry of Industry and IDEA-Efficiency and Saving Strategy in Spain (E4) 2004-2012)

Residential buildings	8.9 Mtoe	61.40%
Tertiary sector	5.6 Mtoe	38.60%
Office buildings		33.00%
Restaurants-accommod		30.00%
Commercial buildings		22.00%
Hospitals		11.00%
Educational buildings		4.00%
End-use equipments		4,00%

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ASSESSING THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

SPAIN

Buildings sector (2000)

Greenhouse gas emissions

25 million tonnes of CO_2
(12.0% of the total Spanish dioxide emissions)

Residential sector	68,91%
Commercial/institutional sector	31,09%

(United Nations Framework Convention on Climate Change, National Inventory Submissions 2005. Spain)

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CATALONIA

Residential sector (2005)

Final energy consumption

2,16 Mtoe
(average energy consumption in a dwelling 7600 kWh/year.)

Heating	33%
End-use equipments	33%
Water heating	26%

Greenhouse gas emissions

4.2 million tonnes of CO_2
(average greenhouse gas emissions in a dwelling: 1290 Kg of CO_2/year)

(Generalitat de Catalunya.La contribució de l'habitatge a Catalunya a la reducció d'emissions de gasos amb efecte hivernacle, 2006).

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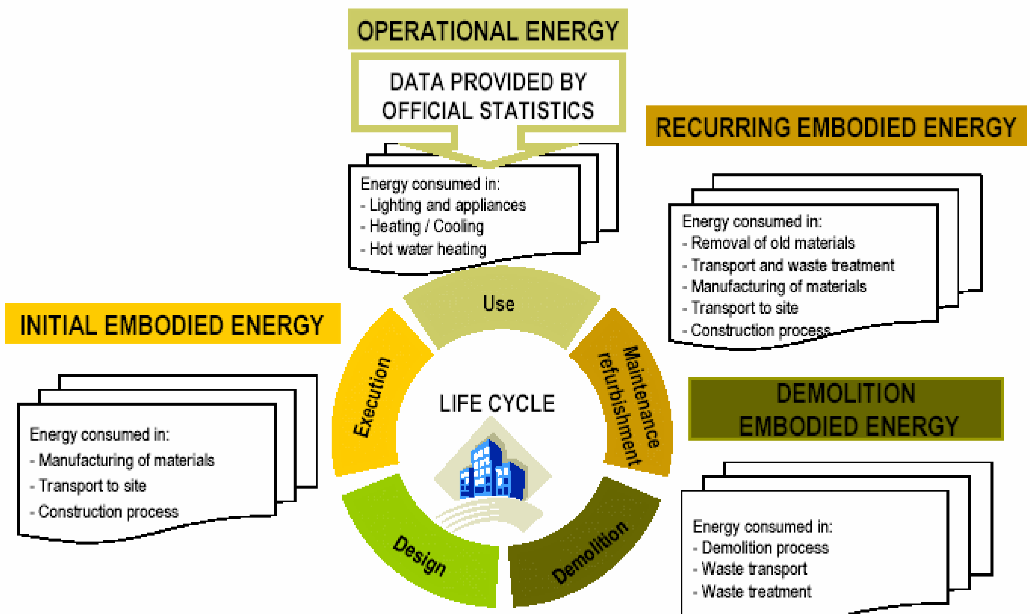
EFECTIVENESS GAPS ON THE ASSESSESSMENT OF THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE



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EFECTIVENESS GAPS ON THE ASSESSESSMENT OF THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

Results from three single-unit dwelling located in Sweeden with a lifespan of 50 years [Adalberth, 1997b]:

Manufacturing energy use during construction phase	3.00 GJ/m^2	10.07%
Energy use for construction materials transportation during the construction phase	0.13 GJ/m^2	< 1%
Energy use during the erection of the building	0.24 GJ/m^2	< 1%
Manufacturing energy use during renovation phase	1.30 GJ/m^2	4.36%
Energy use for construction materials transportation during the renovation phase	Negligible	-
Energy use during the occupation	0.50 GJ/m2·year	83.95%
Energy use during the demolition of the building	0.04 GJ/m^2	< 1%
Energy use for waste transportation during the demolition phase	0.08 GJ/m^2	< 1%

Embodied energy ≈ 16.00%

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EFECTIVENESS GAPS ON THE ASSESSESSMENT OF THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

Results from 24 buildings located in Australia with a lifespan of 50 years [Pullen, 2000]:

Initial manufacturing energy	5.90 GJ/m^2	9.73%
Recurring manufacturing energy	4.00 GJ/m^2	6.60%
Energy use during the erection of the building	0.23 GJ/m^2	0.38%
Energy use in on-site activities during maintenance	0.17 GJ/m^2	0.28%
Energy use during the occupation	50.30 GJ/m^2	83.00%
Energy use during the demolition of the building	-	-

Embodied energy: 17.00%

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EFECTIVENESS GAPS ON THE ASSESSESSMENT OF THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

Results from an office building located in Finland with a lifespan of 50 years [Junnila et al., 2006]:

Initial embodied energy	4.50 GJ/m^2	**8.51%**
Recurrent embodied energy	2.15 GJ/m^2	**4.07%**
Demolition embodied energy	0.18 GJ/m^2	**0.34%**
Energy use during the operational phase	46.00 GJ/m^2	87.07%

Embodied energy: 12.92%

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EFECTIVENESS GAPS ON THE ASSESSESSMENT OF THE IMPACT OF THE SPANISH BUILT ENVIRONMENT ON CLIMATE CHANGE

Results from an office building located in Canada with a lifespan of 50 years [Cole and Kernan, 1996]:

Initial embodied energy [GJ/m^2]		Recurring embodied energy [GJ/m^2]			Operational energy [GJ/m^2·year]
		25 years	50 years	100 years	
With underground parking					
Wood	**4.54**				
Steel	**5.13**	**2.56**	**6.55**	**14.74**	1.05-1.76
Concrete	**4.79**				
No underground parking					
Wood	**4.26**				
Steel	**4.86**	**2.52**	**6.32**	**14.44**	0.95-1.63
Concrete	**4.52**				

Embodied energy: 12.00%÷18.00%

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LEGAL FRAMEWORK

1979 First World Climate Conference by the World Meteorological Organization

1988 Creation of the Intergovernmental Panel on Climate Change by World Meteorological Organization and the United Nations Environment Programme

1992 United Nations Framework Convention on Climate Change

↳ Stabilize emissions of greenhouse gases at 1990 levels by the year 2000

1993 Council Directive 93/76/EEC to limit carbon dioxide emissions by improving energy efficiency (SAVE)

↳ All Member States shall limit CO_2 emissions by improving energy efficiency in buildings (implementing energy certification programs, etc) not later than 31 December 1994.

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LEGAL FRAMEWORK

1997 Kyoto Protocol

↳ Reduce emissions of greenhouse gases by 5% in relation to 1990 levels between 2008 and 2012

2002 Energy Performance Building Directive

↳ Methodology for calculating the energy performance of buildings
Application of performance standards on new and existing buildings
Certification schemes for all buildings

2003 Emission Trading Scheme (Directive 2003/87/EC)

2005 Spanish National Allocation Plan (2005-2007 and 2008-2012)

↳ Total quantity of CO_2 emission allowances available and how this target is divided among the various individual plants covered by the system: energy, steel, cement, glass, brick making, and paper/cardboard.

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LEGAL FRAMEWORK

1997 Kyoto Protocol

→ Reduce emissions of greenhouse gases by 5% in relation to 1990 levels between 2008 and 2012

2002 Energy Performance Building Directive

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→ Total quantity of CO_2 emission allowances available and how this target is divided among the various individual plants covered by the system: energy, steel, cement, glass, brick making, and paper/cardboard.

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LEGAL FRAMEWORK

ENERGY PERFORMANCE BUILDING DIRECTIVE	
Energy efficiency requirements:	Building Technical Code
Thermal installations:	Revision of the current Spanish Regulation on Thermal Installations in Buildings
Energy certification schemes for buildings:	Royal Decree 47/2007 - Basic procedure for the certification of energy efficiency in the construction of new buildings

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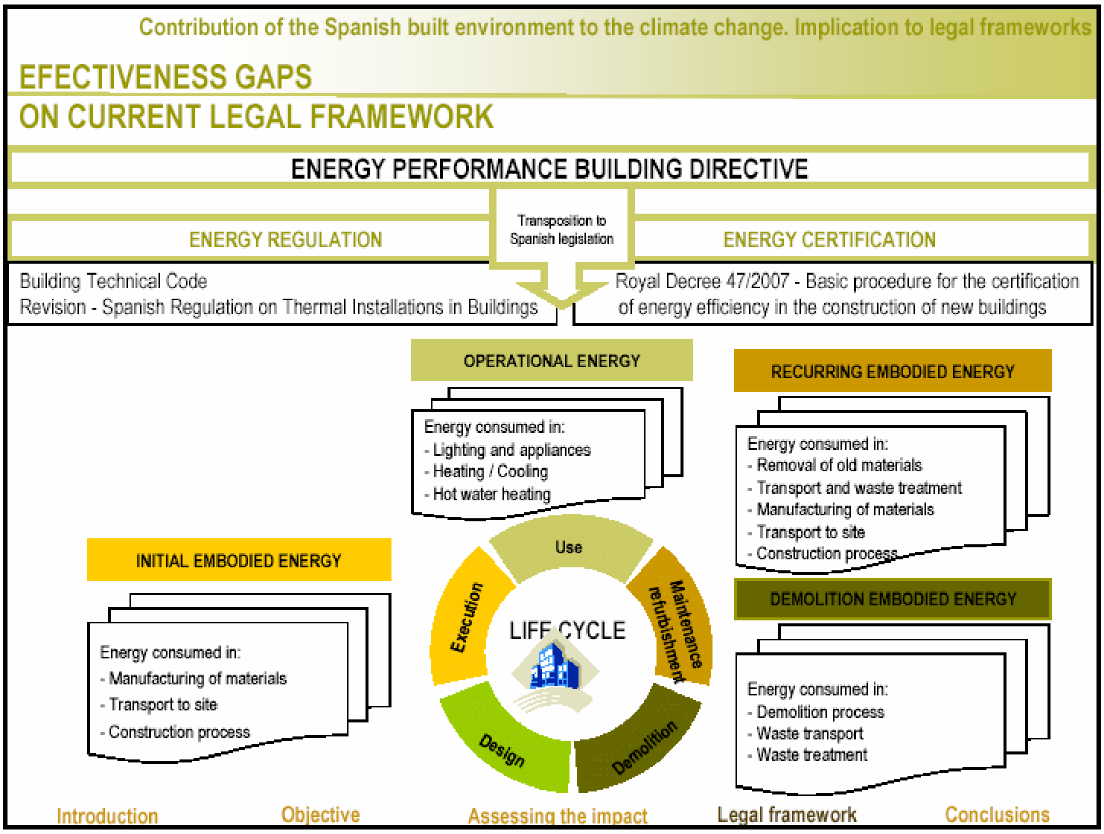
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EFECTIVENESS GAPS
ON CURRENT LEGAL FRAMEWORK
ENERGY PERFORMANCE BUILDING DIRECTIVE
ENERGY REGULATION
Transposition to Spanish legislation
ENERGY CERTIFICATION
Building Technical Code
Revision - Spanish Regulation on Thermal Installations in Buildings
Royal Decree 47/2007 - Basic procedure for the certification of energy efficiency in the construction of new buildings
OPERATIONAL ENERGY
Energy consumed in:
- Lighting and appliances
- Heating / Cooling
- Hot water heating
RECURRING EMBODIED ENERGY
Energy consumed in:
- Removal of old materials
- Transport and waste treatment
- Manufacturing of materials
- Transport to site
- Construction process
INITIAL EMBODIED ENERGY
Energy consumed in:
- Manufacturing of materials
- Transport to site
- Construction process
LIFE CYCLE
Use
Maintenance refurbishment
Demolition
Design
Execution
DEMOLITION EMBODIED ENERGY
Energy consumed in:
- Demolition process
- Waste transport
- Waste treatment
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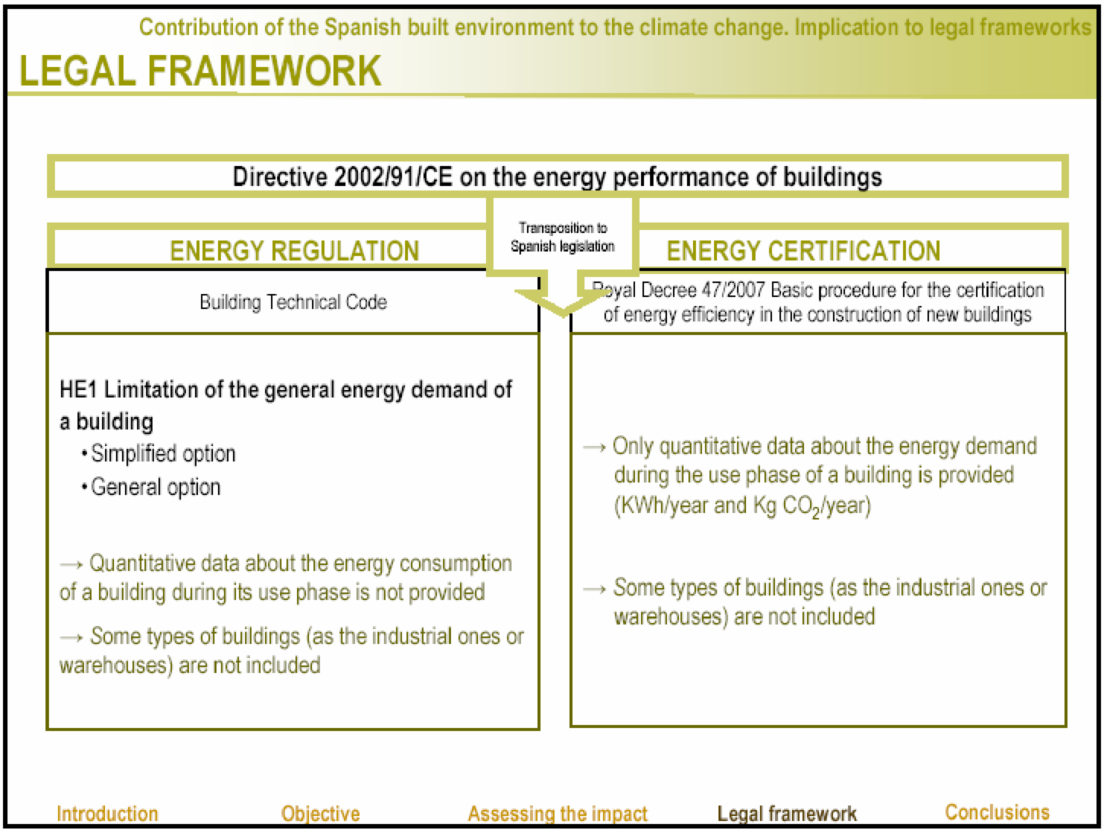
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LEGAL FRAMEWORK
Directive 2002/91/CE on the energy performance of buildings
ENERGY REGULATION
Transposition to Spanish legislation
ENERGY CERTIFICATION
Building Technical Code
Royal Decree 47/2007 Basic procedure for the certification of energy efficiency in the construction of new buildings
HE1 Limitation of the general energy demand of a building
• Simplified option
• General option
→ Quantitative data about the energy consumption of a building during its use phase is not provided
→ Some types of buildings (as the industrial ones or warehouses) are not included
→ Only quantitative data about the energy demand during the use phase of a building is provided (KWh/year and Kg CO_2/year)
→ Some types of buildings (as the industrial ones or warehouses) are not included
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CONCLUSIONS

SPANISH BUILDINGS SECTOR

OPERATIONAL ENERGY	16% - 27% of the total final energy use 12% of total greenhouse gas emissions

+

EMBODIED ENERGY	≈ 18% of the total final energy consumption, depending on: ▪ the anticipated useful life of the building ▪ frequency of maintenance ▪ type of construction ▪ pattern of occupants' energy consumption ▪ climate

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ENERGY REGULATION

- Buildings sector is not included within the Spanish Emission Trading Scheme.
- Energy efficiency requirements are introduced at the building design stage in line with the Energy Performance Building Directive by means of the Building Technical Code, the revision of the current Spanish regulation on thermal installations in buildings and the Royal Decree on energy certification in buildings.
- All three instruments are only focused on the operational energy
- They does not cover all types of buildings

ENERGY CERTIFICATION

- It is only focused on the operational energy
- It does not cover all types of buildings

REPORTING ENERGY CONSUMPTION

- Embodied energy should be taken into account when reporting energy consumption because **what is not assessed can not be improved**

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CONCLUSIONS

FURTHER STEPS

DEVELOPMENT OF AN HOMOGENEOUS MODEL OF LIFE CYCLE ANALYSIS FOR THE EVALUATION OF THE ENERGY CONSUMPTION OF THE "INDUSTRIAL PLANT" SYSTEM AND ITS ASSOCIATED EMISSIONS

The model will quantify the energetic consumption of industrial buildings along all their life cycle (and their associate emissions) and it will allow the comparison of their energetic performance.

- The model will contribute to the definition of the sustainable specification in the planning phase
- This method will be also useful for all design stakeholders who would have a decision making tool in terms of environmental incidence of different project solutions.
- It will establish the basis for a future environmental certification of industrial buildings, including all the life cycle of a building

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