COMPARISON OF SUSTAINABLE ARCHITECTURE FROM TWO EUROPEAN COUNTRIES THROUGH INDICATORS (THE NETHERLANDS AND SPAIN)

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ABSTRACT

The Netherlands was pioneer in incorporating ecological concern to its aims and politics. By 1972 the Dutch government spread the message of responsible and ecologic production and consumption, wheras Spain was still far from considering sustainability as a main concern. The way that both countries have followed is worth studying and comparing. In this research, the status of the construction sector in Spain and the Netherlands will be analysed, by using indices. Both countries enjoy a similar HDI (Human Development Index), and differences, among others, in their constructive development, as the results show.

Considering sustainability as a compound result of environmental, social and economical matters, diverse indices related to these aspects have been searched for in order to locate construction in its real context. This way, proper comparisons can be established, which will help to learn and improve, both in the general aims and in the process of construction. The aims will be analysed by comparing existing and possible situations. The processes will be analysed by indicating the areas whose indices should be established and studied in more depth, and detecting as well the weaknesses of knowledge that should be improved.

As for the temporal development, the indices selected were those related to sustainability in the different stages of the life cycle of a building; from the pre-design until the demolition of it. Where necessary, trends have been defined by presenting temporary cycles. The indices have been obtained from several official organisations considering the availability of data about both countries as for concept, time and reliability. This is the case of institutes, universities, congresses and research centres. In some cases, the sources of the information are common to both countries: EU statistics.

All conclusions establish forcefully, how (in a comparable framework, where differences are not essential) there is a space of improvement and learning that can be shared. It also identifies which areas should be considered as those requiring priority attentions and the trend towards a likely common factor.

1.- The housing market as a factor in sustainable and economic development

This project focuses on the importance of housing as an index for social well-being and equality, of economic development and as an environmental index. As an index of social well-being, the importance of housing production is obvious within the overall context of human development (HDI) In terms of an economic development index, housing, its availability, its ability to be obtained and its sensitivity to the economic world has been more obvious than ever after the crisis. In terms of the indexes strictly related to building, we can say that the direct and indirect energy

expenses combined are closely tied to construction as an industry and construction as energy consumption in air conditioning, heating, etc.
This study will also reflect data associated to the ongoing crisis.

2.- Methodology

Structurally, we establish the field into the following coordinates: space: between the Netherlands and Spain, for the aforementioned reasons. In time: two moments that may set a trend. And the research sector: housing as a factor in social, economic and constructive development. Using the LCA methodology, we have selected possible indicators for the different life-cycle phases (pre-design, design, construction, exploitation and maintenance, dismantling).
Every indicator is valuable, so it was considered important that they all be gathered, even when the research parameters did not coincide. Some relevant data and others will provide a partial vision. However, we have included those which we could acquire directly. The final aim was to consider this study as the first part of a more extensive study, which may be a comparison of the state of building and its relationship to sustainability in both countries.

3.- General context

3.1. Population and land

If Spain was so densely populated as the Netherlands (483[1] inhab/km^2 in 2006), there would be over 260 million habitants in the country. It is not the case; density is much lower, with 87 inhab/km^2. Given Dutch's high population density, it is easier to understand land as a scarce resource in the Netherlands, a country with a long history of land reclamation, in which over 75% of the Gross Domestic Product is earned below sea level. On the contrary, it is water what shows as a scarce resource in most of Spanish territory.
Climatic conditions, natural resources and history are different. Nevertheless some of those issues are comparable, especially if the wide range of climatic conditions in Spain is taken into account. For example, between 1984 and 2004 the average heating degree day[2] (HDD) in the Netherlands was 2.912, for a base temperature of 18°C. This figure is quite far from locations like Barcelona (1505 HDD) or Seville (986,7 HDD) but does not differ so much from another areas, like Burgos (2.384 HDD) or Teruel (2.324 HDD).
One might ask if comparing sustainability of the building sector in both countries makes any sense at all. We believe it does: besides their differences they have a lot in common, and much can be learned from the way(s) each country has tackled its specific conditions.

3.2. Two countries facing a common future

The Netherlands was among the six founding members of the European Economic Community in 1957, whereas Spain joined in 1986. Nowadays both countries share policies on trade, agriculture or regional development. They are part of a single market with a common currency.

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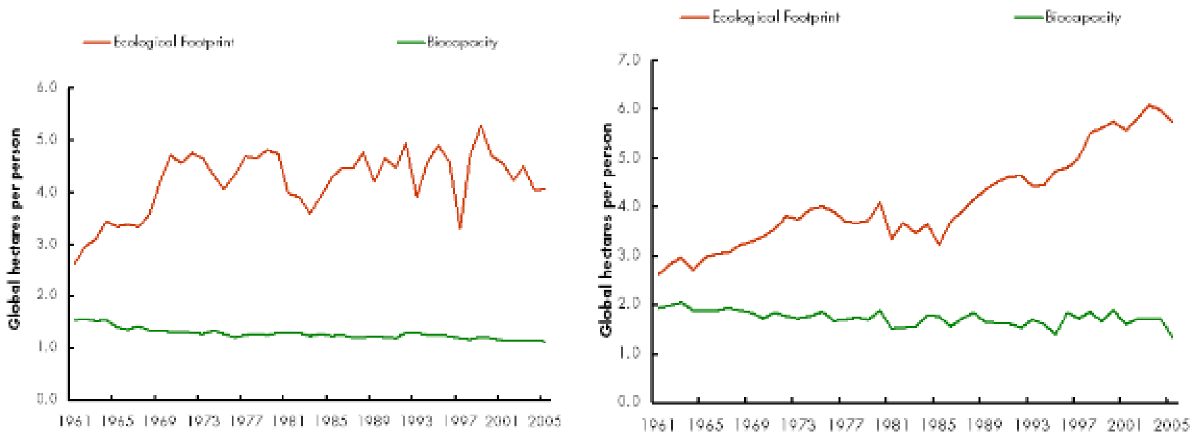
[1] Source of data: Eurostat
[2] Heating degree day (HDD) is a figure that expresses the demand for energy needed to heat a building. It is calculated relative to a base temperature.

If Human Development Index[3] is considered, both countries are on the top of the ranking list. In 2008's report –that represents statistical values for the year 2006– the Netherlands was the 6th, and Spain the 16th. [1]
In both countries inequality distribution of incomes has been raising in the last years. Inequality 20-20 indicator provides a ratio of total income received by the 20% of the population with the highest income to that received by the 20% of the population with the lowest income. In the last report [1] the value was 5.1 for the Netherlands (4.1 in 2000) and 6 for Spain (5.4 in 2000).

3.3. Sustainability in the political agenda

Environmental indicators' trends offer valuable information. The evolution of both countries has been considerably different. For example, regarding CO2 emissions per capita, by 1990 the Netherlands with 9,4 tones/person almost doubled Spanish rate, that was 5,5 ton/person. Fourteen years after, distance has narrowed, the Netherlands emissions' have decreased by 8%, to 8.7 tones per capita in 20004, while Spain raised 38% reaching 7.6 by 2004.
If we consider municipal waste per capita, according to UNDP and Eurostat, it was 322 kg/person in 1989 in Spain, and 522 in 2007 (30% recycled or composted), which means an increase of 62% in 18 years. The Netherlands had 467 kg per capita in 1985 and 630 in 2007 (60% recycled or composted).



The Netherlands Spain

Source: www.footprintnetwork.org

Figure 1. Ecological Footprint and Biocapacity in the Netherlands and Spain. 1961-2005

As a synthesis of different indicators, the ecological footprint[4] is a very useful pedagogical tool. As can be observed (fig. 1) fifty years ago both ecological footprints were similar, whereas Spain benefited from a higher biocapacity. The Netherlands ecological footprint reached soon considerable high values (over 4,5 by 1970) and since then stopped rising, with fluctuating values between years and a decreasing constant trend since 2000. On the contrary Spain keeps on increasing its Ecological footprint, which was stabilized in times of crisis, between 1973 and 1985, but which has overpass Dutch indices and reached even 6 in 2005.
Processes are complex and there is no easy cause-effect explanation. Nevertheless some facts should be highlighted. As early as 1972, the Dutch government

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[3] Human Development Index is updated yearly by the United Nations Development Program (UNDP)
[4] The Ecological Footprint has emerged as the world's premier measure of humanity's demand on nature. It measures how much land and water area a human population requires to produce the resource it consumes and to absorb its wastes, using prevailing technology. (www.footprintnetwork.org)

introduced the concept of “ecologically adjusted behavior,” although a comprehensive policymaking was not agreed until 1989 [2], when the Netherlands' first National Environmental Policy Plan was published and sustainability has been high on the political agenda ever since. [3] In Spain there is not such a general environmental plan. Sustainability concepts have been incorporated into laws and regulations –mostly with a sectorial basis– in a process mainly boosted by European directives. Spain was obliged to adapt to European concerns about energy efficiency, renewable energy, quality of products… while the Netherlands often anticipated them. [4]

4. Pre-design stage

Before any architecture project begins many decisions have been taken which will impact in the ability to achieve sustainability. The sooner sustainable aims are introduced in the building process, the easier to fulfill them.
That is why, before considering different topics of sustainable construction, land consumption and urbanization process will be analyzed.

4. 1. Changes in land uses

Land use indicators are based on the analysis of CORINE land cover database. According to its nomenclature, artificial surfaces include urban fabric, industrial and commercial sites, road and railway networks and associated land, as well as port areas and airports; mine, dump and construction sites; and artificial non-agricultural vegetated areas.
Urbanization process implies that land is diverted away from natural ecosystems for urban areas and other human uses. As a result, natural patrimony and cultural landscapes are destroyed, not only in those urbanized areas, but also in their surroundings, degraded under urban and infrastructures’ influence. [5]

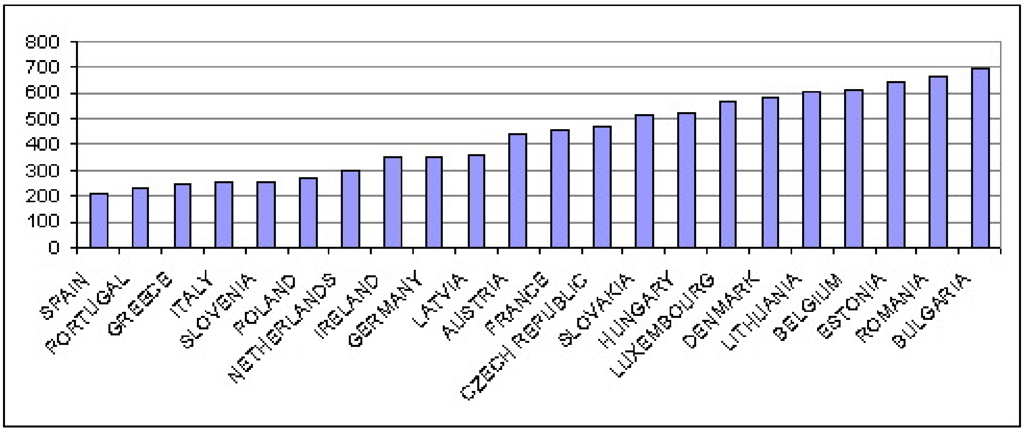

Figure 2. Artificial land per capita in European countries[5].

As can be observed in Figure 2, in 1990 Spain, along with other Mediterranean neighbors, were the most efficient European countries regarding artificial land consumption per capita. Mediterranean city patterns –compacity, self-containment, relatively dense areas, mixed uses…– were behind that efficiency. The Netherlands was also included in the group of land-efficient countries, its index of land consumption per capita is considerably better than other neighbor countries, specially if compared to Belgium.

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[5] Source of data: Eurostat and EEA

Nevertheless since 1990 there has been a great land transformation in both countries. Between 1987 and 2000 land occupied by artificial uses in Spain increased by 25% while population only increased by 5%. In the Netherlands, even if the difference between both figures was not so large, is considerable: artificial uses increased by 22% and population only 7%.
Recent urban expansion was not due to population pressure, other factors like growing number of households and average residential space per capita, inner city problems, improved motorways and road connections, new lifestyles in suburban environments, an increased number of second homes and speculative inversions in housing are driving the process. Hence, the artificial surface per capita in the areas developed in Spain between 1990 and 2000 was almost eight times larger than that of 1990.

	POPULATION	DWELLINGS (HAB/VIV)	ARTIFICIAL LAND (HA) (% TOTAL LAND)	ARTIFICIAL LAND		URBAN FABRIC	
				M2/HB	M2/VIV	M2/HB	M2/VIV
SPAIN							
1990	38.826.297	17.220.399 (2,25)	669.993 (1%)	173	389	124	281
2000	40.049.708	20.946.554 (1,91)	838.453 (2%)	209	400	139	265
1990-2000	Δ 3%	Δ 22%	Δ 25%	1.374	452	591	194
NETHERLANDS							
1990	14.892.574	5.802.361 (2,56)	370.704 (9%)	249	639	171	438
2000	15.863.950	6.589.662 (2,41)	453.827 (11%)	286	689	188	453
1990-2000	Δ 7%	Δ 14%	Δ 22%	856	1.055	453	559

Table 1. Population, artificial land and urban fabric in Spain and the Netherlands. Evolution 1990-2000[6]

4. 2. Sustainable neighbourhoods

Urban developments have been the main factor of artificial land extension between 1990 and 2000, although its relative weight has been diminishing. In Spain 43% of new artificial land corresponded to urban fabric and in the Netherlands it entailed 53% of the total artificial land developed. Nevertheless in both countries economic sites and infrastructures stand out as increasingly relevant factors of land consumption.
Dutch ecocities' achievements like those of Ecolonia, Ecodus or Oikos are often highlighted. They are widely accepted as a reference for sustainable neighbourhoods. "In the Netherlands, significant experimentation with sustainable development projects began in the early 1990s, partially funded by the Dutch government. (…) [In this country there are] special green investment funds, which allow homeowners, once the Project is certified as a green Project, to obtain a bellow-market mortgage rates". [beatly] Nonetheless those politics oriented to promote sustainability coexist with government's measures that "stimulates larger size homes with higher ceilings and a lower housing density. In the second half of the 1990s national and local governments in the Netherlands set their sights on a housing differentiation with a higher than ever share of one-family homes. These market-led developments have almost certainly reduced the sustainability of Housing". [5]

6 Source of data: Eurostat, EEA, INE and CBS

A effective politic for sustainable housing, should address the main source of unsustainability, in order to reconsider how many and which type of dwellings are being built.

5.2. Shifting housing patterns

In the Netherlands, since Second World War, "the number of people per household, especially in the towns, has dropped from about 5 to 2.5; and this number continues to fall. This, by the way, was the main reason for scarcity of housing in the later post-war period, and for the urban explosion after 1960. There are not only great variations in time in the number of people per household, but also large regional differences. The number of people per household is the lowest in the Randstad and here the numbers have decreased the most rapidly in the last 50 years. (…) The extension of urban area was caused, among other things, by fewer people living in one household (family dilution). [6]
In Spain a similar process has taken place. In 1950 there was an average of 4,2 people per household and in 2000 there were only 1,91. There is nonetheless a significant difference between both countries. In Spain the amount of empty or secondary dwellings accounts for 32% of total dwellings. If index are calculated on the basis of principal dwellings, the results would be quite different, with 2,8 inhabitants per dwelling.

6. Design Phase

Within the industrial world, the influence of both sectors in the own country's economy cannot be clearly differenced. The number of jobs in construction was 2,490,000 in 2004 in Spain, and 500,000 in the Netherlands. [7]
The data included is the data over which a reasonable comparison can be made, about the minimum performance that a dwelling should be able to reach in both countries, in the areas of water (availability of supply and price), of thermal comfort (recommended temperatures, isolation and transmission coefficients)

6.1. Natural resources: water usage.

6.1.1 Supply of drinkable water

Dutch rules recommend the supply of water in relation to the number of rooms of a dwelling (the living room counts as a room) in the following manner: from 100 to 150 litres per day and dwelling of up to 2 rooms; from 150 to 200 litres per day and dwelling up to 3 rooms, from 225 to 300 litres per day and dwelling up to 4 rooms, and from 300 to 350 litres per day in dwellings with 5 rooms. [8]
In Spain, the water supply for domestic use depends on local and regional regulations, and on local water suppliers. In the case of a city in Castilla y León, such as Valladolid, the local regulation states that "each dwelling will be provided with enough clean and drinkable water, and the minimum amounts required for appliances such as dishwashers and washing machines will be guaranteed". [9] The Local Water Service does not state a specific minimum amount either, but it does state an ambition to improve the efficiency in the usage of water, which reached 400 litres per person per day in Spain in 1984. [10]
Typically, the standardised supply amount is 200 litres per person per day. The number of occupants is stated in the local regulations according to the number of bedrooms and if they are single or double. A standardised dwelling of 90 m2 could have three double bedrooms or two double bedrooms and one single bedroom, resulting in an estimate of 900 to 1200 litres per day per dwelling. Statistics state,

however, that the number of dwellers has been considered a constant rate, of one person per 30 m2, which corresponds with the Building Census 1991-2000 of the INE. In this case, the supply for a 90 m2 house would be of 600 litres per day, numbers which stay close to the estimates shown previously.

Also, the technological building rules (NTE), which were broadly used and recommended in Spain from the 1970's recommended a water supply according to the population core where the dwelling was located: 630, 945 and even 1260 litres per day for dwellings in population centres of up to 1,000 inhabitants, from 1,000 to 6,000 inhabitants and over 6,000 inhabitants, respectively. [11]

The current CTE in the basic DB-HS document does not specify a value for this supply, which is left to decide by the consumer, but it does contain several measures aimed at a more efficient water utilisation. There are only some references, such as in the section dedicated to "determination of the size of de-calcification machines" (chapter 4.5.4.2., document CTE-DB-HS) where, referring only to warm sanitary water equipment, it is stated "The minimum amount will be of 80 litres per person per day"

6.1.2 Water prices

The price of water for domestic use depends on its consumption. For a consumption of 200m3 of water a year, in Spain, the prices of the water supplies for domestic use in 2006 were about €1,20 /m3, even though these prices fluctuated in different regions. In the last 5 years, these prices have increased 20%, in nominal terms, and 5,71% in real terms. [7]

The price, for the same consumption range, in the Netherlands, is €3/m3 as an average, according to the sources. Some other companies have set other prices, such as Duinwaterbedrijf Zuid-Holland, at €1,32/m3 [12]

6.1.3 Water utilisation related to construction

In the Netherlands, the water consumption related to construction was 7,2 mio m3, which can be estimated in per million inhabitants. In Spain, for the same year, the consumption of water in the same are was 45,2 mio m3, which can be estimated at per million inhabitants.[7]

6.2 Climate and acclimatisation

In the Netherlands, the annual total degrees-day was 2734 in 2006, as an average of different Dutch sources [13]

The difference in the climate of both countries is important, but it is not so great if specific places within the Spanish territory are chosen. As an example, Madrid has a degrees-day, in a 20 degree base, of 2613. The CTE states several climate zones, some of which could be compared with the Netherlands. An example is the area E1, where the city Burgos sits, which has a degree-day on base 18 degrees of 2384. the difference in the climate between both countries is not so great. [14]

The only climate-related variable chosen for this comparison is temperature, as "only the average monthly temperature has a relevant impact on the consumption of electricity and gas", against other groups of climate variables such as relative humidity, precipitation rates, pressure or presence of the sun or the speed of the wind, according to Climent or Valor's work (2003), made in Spain between 1987 and 1993. [15]

6.2.1 . Recommended temperatures

Recommended temperatures:

PB: Living room, 20º, bedroom, 18º, kitchen, 18º, offices, 20º [16]

ES: Winter, Living room, 22º, bedroom, 20º, kitchen, 18º, offices, 22º

Spanish climatology is softer in the winter and assumes that the Spanish rate for heating consumption is 41,7%, against the same rate for the rest of Europe, which is 67,9%. The impact of air conditioned, due to its seasonal nature, does not reach important consumption levels, even though it contributes to the generation of peaks in the electricity demand which can sometimes cause problems with local electricity suppliers in the times of the summer when temperatures reach the highest levels.

6.2.2 Thermal isolation

In the Netherlands, the minimum compulsory thickness of the thermal isolation is 80 mm in exterior surfaces of living rooms, bedrooms and kitchens, and of 60 mm in roofs. Assuming that a standard average isolator has a lambda value of 0.040 W/m2k, for example, mineral wool, a total transmission in the main wall could be 0,42 W/m2k and 0,38 W/m2k in an inclined roof. In Spain, and according to the recent CTE, document DB-HE, for the climate zone E1 (the example of Burgos) the minimum average transmission of façade walls is 0.57 W/m2k, and the minimum acceptable transmission in roofs is 0.35 W/m2k.

6.3. Heavy or light construction: incorporated material energy.

Beyond local criteria for distribution, general purpose and aesthetic and constructive traditions, it is possible to establish comparisons in terms of heavy or light construction, in relation to the use of construction materials, whose incorporated energy, besides weight and other variables, are a part of the environmental impact study of the building.
Vázquez Espí [17] established that “a typical residential building in Europe in the 1970’s required 1000 kWh/m2, which can be translated to 3600 MJ/m2.
Wilting y van Rossum [18] have established the comparison between two similar housing, conventional one and another about minimal energy. Both housing have 125 m2, and volume between 302 and 341 m3. The difference between both was that the “minimal energy house” was focussed in saving energy maintenance. The invoiced energy used in construction in this minimal energy house was 642,1 GJ. The invoiced energy used in construction in the conventional house was 492,9 GJ. So, it could be estimated 5128,8 MJ/m2 in the minimal energy house, and 3863,2 MJ/m2 in the conventional. What is, the minimal energy house spent more invoiced energy in construction phase. But along the maintenance phase, considered on 75 years, the performance of saving energy compensates this difference.
González Díaz and García Navarro (2004), in a similar project carried out in Spain in 2004, established a comparison between two types of housing with similar characteristics (semi-detached 125 m2, plus a 65 m^2 basement). However, in this case, the “low energy” building was built, besides relative to the energy required for its maintenance, to the energy incorporated into the construction phase, selecting the construction materials with the least environmental impact. This way we obtained the figure for incorporated energy of 7803.03 MJ/m^2, versus the 12,304.34 MJ/m^2 of a conventional Spanish building [19].
Part of the reason in the difference in results between the Dutch and Spanish studies is the high energy and material needs invested in building the basement (moving the earth, concrete land containment structure, etc.). Another later study performed on the same building established a 27.28% reduction in CO2, achieved by the type of construction: using low impact environmental materials [20].

6.4. The use of renewable energy

There is no distinguishing data in the use of building specific renewable energies. However, we can note the use of solar energy which is mainly used as solar thermal energy in buildings. The production of solar energy in both countries in 1000 TOE units (Ton of Oil Equivalent, 1 TOE= 41,868 × 10^9 J) is as follows:

In the Netherlands: 9 in the year 2000, 22 in the year 2005 (1.29 per million inhabitants)

In Spain: 33 in the year 2000, 65 in the year 2005 (1.62 per million inhabitants) [7].

After the appearance of the CTE regulation in Spain, this data, which was prior to this standard, will be greatly modified. The CTE regulation foments the use of renewable energies, particularly solar thermal energy for producing hot water.

7. Maintenance phase

From the perspective of resource, energy and other usage, maintenance is the most implicated phase in the building's life-cycle, and towards which the majority of efficiency measures are aimed. Below we discuss the use of energy and water.

7.1. Domestic water consumption

Spanish domestic consumption of water have been valuated as very high: in 1984 it was 400l per inhabitant/day [10]. While it varies widely per region. For example, in 1996 it oscillated from 125 litres per inhabitant/day in the region of Madrid, to 300 in the community of Cantabria [21].

According to Eurostat, the average consumption of water in Spain in 2004 was 2700.9 million m3, which is equivalent to about 67.5 m3 per inhabitant/year.

The average consumption in the Netherlands: 45 m3 per person/year, according to a specific company. [22] According to Eurostat, the average consumption of water in the Netherlands in 2004 was 720.0 million m3, which is equivalent to about 42.35 m3 per inhabitant/year.

7.2. Average home energy consumption

According to the SenterNovem Institute [16], gas consumption per household in the Netherlands in 2004 oscillated relative to the type:

- apartment in a middle floor: 1173 m3
- isolated home: 2624 m3,
- two-story, semi-detached homes: 1920 m3

This index depends on the home's date of construction:

-homes built between 1945 and 2000: 1946 m3 of gas per home/year

-homes built after 2000: 1485 m3 gas per home/year.

The same sources establish the energy consumption of privately owned homes at 1893 m3 gas/year versus rented homes at 1440 m3 of gas/year.

Koene and Knoll [23] cite the energy consumption in terms of primary energy at 260 kWh/m2 per year in semi-detached homes traditionally build in the Netherlands from 1945 to 1975, with an annual gas consumption of 2000 m3 and electric consumption of 3350 kWh.

The energy consumption of homes in Spain is as follows:

According to the Ministry of Housing, the consumption of energy in the Building Sector rose in 2005 to 18,123 ktoe. Of this consumption, 10,793 ktoe corresponds to domestic energy consumption, which is 10% of the national energy consumption. Meanwhile, total domestic energy consumption is distributed as follows for an

average home: heating (41.7%), hot water (26.2%), lighting (9%) and air conditioning (0.4%). [24]
According to Prats, Macias et al. [25], the average consumption for the average home in all of Spain, attributed to heating, hot water, lighting and cooling is 80 kWh/m^2. This consumption only includes the buildings´ fixed installations. The previous consumption value for 2000 established that 15.5% of homes were equipped with air conditioning, according to the Spanish Population and Housing Census .
The documentation in which the latest energy certification regulations are based, establish consumption values prior to considering the CTE-HE´s minimum individual contribution [26]. For Burgos, a city in the E1 climate zone, the following values are established:

For heating and cooling, and hot water demand in apartment blocks: Burgos:

Heating demand	77.1 kWh/m^2
Cooling demand	0.00 kWh/m^2
Hot water demand	13.8 kWh/m^2
Electric Primary Heating	111.8 kWh/m^2

For single-family homes:

Heating demand	113.1 kWh/m^2
Cooling demand	0.00 kWh/m^2
Hot water demand	18.8 kWh/m^2
Electric Primary Heating	164.0 kWh/m^2

The appearance of the CTE regulation requiring the use of solar thermal energy will result in an obvious increase in solar thermal energy in Spain.
In the Netherlands the increase in solar thermal energy: from 1990 to 2003 it was 1.2%. The increase in photovoltaic solar energy: from 1990 to 2003 was 0.6%

8. De-construction phase

For this index they have used the data on domestic and construction waste.
The amount of waste produced is reduced in the Netherlands, at about 4.8% since 2000. In 2007 there were 60.2 million tons, which equals a decrease of 0.6 million tons relative to the previous year. The origin of waste is attributed to the following: 39.0 % to construction, 27.6% to industry, 15.1% to consumers, and the rest to other uses. [27]
The production of solid urban waste in Spain in 2005 was 536.9 Kg/per/year
The production of solid urban waste in the Netherlands in 2005 was 624.0 Kg/per/year [28].
In terms of urban waste management in Spain, selective collection was 11% in 2004. In this European context, the data available for Spain shows that Spain is among the countries that sends the highest amount of its waste per person to landfills. In Spain 317 kg/per in 2005 did so (estimate value), compared to the lower figure of 100 kg/per registered in the Netherlands, which is very close to 30 kg/per.
Waste management indexes: In Spain 60% is sent to landfills, 10% to incinerators, 13% is recycled and 17% to compost.
In the Netherlands these percentages were: 3% to landfills, 38% to incinerators, 32% was recycled and 28% to compost.[29]

9. Conclusions

There is enough data for comparison, despite each country's different characteristics. First of all, the energy consumption data establishes the importance of creating efficiency measures, which the Spanish CTE attempts to do. We can expect that with the use of this regulation, while still in its early stages, the energy consumption trend should be considerably reduced. The use of renewable energy will probably turn out as one of the positive points for Spain in this comparison.

It is also very important to note that Spain, with its increasing desertification, poses a lack of water resource management. In conclusion, waste management in Spain is a topic requiring necessary and urgent improvement.

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