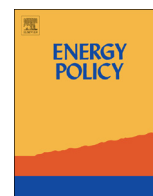




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Energy and environmental evaluation of municipal facilities: Case study in the province of Barcelona



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HIGHLIGHTS

- Energy consumption and GHG emissions of 978 municipal facilities are analysed.
- The average annual energy consumption per facility is 130 MWh.
- The average annual energy consumption per facility by surface area is 118.8 kWh/m².
- The average annual GHG emissions in the facilities studied are 40.0 kg CO₂ eq/m².

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ABSTRACT

The service sector is extraordinarily important for the European economy, as it accounts for 75% of the GDP. Yet it is also a huge consumer of energy, especially in urban environments. Municipalities have the authority to develop and manage municipal services, and as a result the European Commission drew up the Covenant of Mayors in which the signatory municipalities pledge to reduce their CO₂ emissions by 20% of their 1990 rates. Sustainable Energy Action Plans (SEAPs) emerged from this covenant with the goal of analysing the current consumption patterns and compiling the actions that the municipalities should undertake in order to fulfil their pledges.

This article focuses on analysing the energy consumption and greenhouse gas emissions of 978 municipal service facilities in the province of Barcelona in the year 2005. The average consumption per facility by surface area is 118.8 kWh/m². Regarding greenhouse gas emissions, the average annual emissions in the facilities studied in the province of Barcelona were 40.0 kg CO₂ eq/m².

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1. Introduction

The state of the environment is intrinsically linked to the consumption of resources and energy by the different economic sectors (European Environment Agency, 2007). Energy consumption plays an important role in the development of the world economy, and in industrialised countries energy consumption mainly comes from three areas: transport, industry and a third area that includes agriculture, the service sector and the residential sector (Pérez-Lombard et al., 2007).

1.1. Cities, energy and climate change

The service sector originated in and is closely tied to cities. Around the world, even though cities only occupy 2% of Earth's land area (UN, 2007), they are the home to more than 50% of the world population (Mehra and Jørgensen, 1997; European Commission, 2008) and are the centre of production, distribution and consumption of the human species. This means that they have a huge impact on all the biological, physical and chemical cycles. If we focus solely on the energy vector, two-thirds of world energy is consumed in cities (European Environment Agency, 2007; International Energy Agency, 2008b; Ash et al., 2008).

The European Union is the most urbanised zone in the world (Mehra and Jørgensen, 1997). In 2005, 75% of Europe's population was concentrated in just 10% of the land area on the continent (European Environment Agency, 2005). Given this context, since

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the First European Conference on Sustainable Cities and Towns was held in Aalborg (Denmark) in 1994, different European cities have signed the Aalborg Charter, in which they pledge to participate in initiatives from the local Agenda 21. At the same time, the European Sustainable Cities and Towns Campaign (European Commission, 1996) got underway with the goal of fostering sustainable development by closing natural resource, energy and water cycles.

1.2. Sustainability in the service sector

The service sector operates in different kinds of buildings which meet a wide variety of uses and have different kinds of energy applications (Pérez-Lombard et al., 2007). Traditionally, studies on energy consumption and efficiency have focused on the industrial sector, the residential sector and transport, with no in-depth study of the service sector since it is the one with the lowest consumption in absolute terms (Farreny et al., 2008). However, the service sector is notably important in relative terms: in 2005 it accounted for 11.3% of total energy consumption and 27.4% of electrical consumption in the EU-27 countries (International Environment Agency, 2008). Despite these figures, there is still no social consciousness about the environmental importance of this sector, even though it requires a major influx of material resources and energy (Carpintero, 2003, 2005).

Regarding the energy consumption of the service sector worldwide, it consumes 13% of the world energy demand, while 50% of the world energy consumption by this sector comes from electricity (International Energy Agency, 2004). Worldwide, the service sector's electrical consumption accounts for 31% of the total electrical consumption of the countries in the International Energy Agency (IEA) (2004).

The evolution in energy consumption by the service sector showed a 37% rise between 1990 and 2005. Even though this rose more slowly in the OECD countries, 73% of this energy consumption took place in these countries (International Energy Agency, 2008a). At the same time, per capita energy consumption varies considerably depending on the city and region (Schipper et al., 1986).

In the context of European cities, we should note the importance of the service sector both economically – in the EU member states the service sector is an extremely important part of the economy, accounting for 75% of the Gross Domestic Product (GDP) (European Commission, 2010; Oliver-Solà et al., 2007; Núñez et al., 2009) – and environmentally, with rising energy consumption. For this reason, an integrated energy analysis is fundamental in assessing the situation and managing the environment properly.

1.3. Services of municipal entities

Municipalities in Catalonia hold the authority in the realms of citizen participation, self-organisation, identity and local representation, environmental sustainability and territorial management, social cohesion, mobility infrastructures, connectivity, information and communication technologies, energy supply and management of economic resources (Law 8/1987, 1987).

They also hold the authority in the following areas:

- security in public areas,
- planning of vehicle and human transit on urban roadways,
- civil protection, fire prevention and extinction,
- urban planning, management, execution and discipline,
- historical-artistic heritage,
- environmental protection,
- supplies, slaughterhouses, fairs, markets and the defence of users and consumers,
- public health protection,

- participation in the management of primary healthcare,
- cemeteries and funeral services,
- provision of social services and the promotion of social reinsertion,
- supply of water and public lighting,
- public passenger transport,
- cultural and sports activities and facilities, employment in free-time activities and tourism, and
- participation in the programming of education and cooperation with the educational administration in the programming of education and public school maintenance, intervention in the management bodies of schools and participation in ensuring compliance with compulsory schooling.

The number of inhabitants in a municipality influences the minimal services which it must provide and consequently the service facilities:

- In all municipalities: public lighting, cemetery, waste collection, street cleaning, supply of drinking water to homes, sewer system, access to population nuclei, pavement of public roadways and monitoring of food and drink.
- In municipalities with > 5000 inhabitants, also: public park, public library, market and waste treatment.
- In municipalities with > 20,000 inhabitants, also: civil protection, provision of social service, fire prevention and extinction and public sports facilities. In the realm of civil protection, the municipalities must draw up basic municipal emergency plans and specific plans should they be affected by special or specific risks. In the realm of social services, the financing must include the town's legally stipulated social services.
- In municipalities with > 30,000 inhabitants, also: decentralised public library services in accordance with a plan of public reading.
- In municipalities with > 50,000 inhabitants, also: collective urban passenger transport and environmental protection; transport service adapted to individuals with reduced mobility (a service which must be provided by all municipalities that are county seats).

To manage their own interests, the municipalities may also perform complementary activities that fall within the aegis of other public administrations, namely ones related to:

- education,
- culture, youth and sports,
- promotion of women,
- housing,
- health,
- environmental protection,
- employment and measures to combat unemployment,
- archives, libraries, museums, music conservatories and fine arts centres, and
- promotion of agricultural structures and provision of agricultural public interest services.

1.4. Sustainable Energy Action Plans in the municipal setting

In 2007, the European Commission approved a packet of measures entitled “Energy for a Changing World” (European Commission, 2008b), which is also known as “20–20–20 for 2010”. This plan set three objectives compared to 1990:

- to lower greenhouse gas emissions by 20% (or 30% if other developed countries pledge to do the same),

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