

HOUSEHOLD ENERGY FOOTPRINT: RESEARCH OUTCOMES FROM THE REGION OF ATTICA

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Abstract

Global climate change is one of humanity's greatest challenges and one of the most important indicators that we are in ecological overshoot. Human activities result in greenhouse gas emissions, with Carbon Dioxide (CO₂) emissions to be the most threatening. The household component (house environment) is considered as an important factor in energy consumption, emitting in the atmosphere remarkable CO₂ quantities.

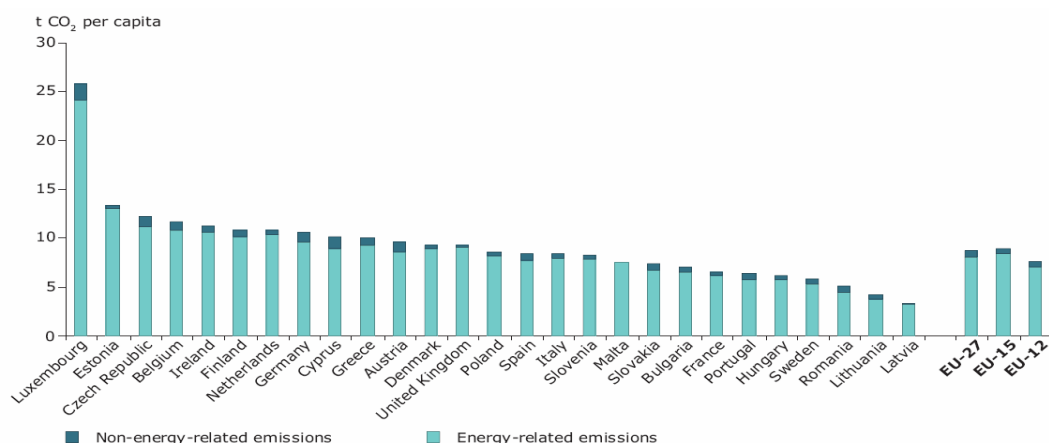
Aim of this paper, is to present the research results from a random sample of 477 households from the region of Attica. For our research, (contacted in the frame of the research activities of the "Environmental Economics" course in the Economics Department of University Piraeus), we used a structured questionnaire, referring to household patterns and energy consumption practices in the house (internal environment and water heating and electric appliances). Basic objective of our research was the calculation and the analysis of household energy footprint (the total consumption of electric energy and the resultant CO₂ emissions). For the data input and the footprint calculation, we used the WWF Greece web-based tool and therefore we applied simple statistical analysis techniques using the SPSS software. Our research results show, that a remarkable percentage of the households in the region of Attica declare ignorance regarding the energy characteristics of their electric appliances and the majority have low ecological awareness regarding to the management of these appliances. Nevertheless, the household energy consumption in the region of Attica, it's not remarkably differentiated from the medium Greek and European household energy consumption and Carbon Dioxide (CO₂) emissions, as have been shown by other official studies. Finally, we propose simple interventions for energy saving in the house, in the context of energy footprint reduction and protection of the environment.

Keywords: Energy consumption, Household, Greenhouse gases, Greece, CO₂ emissions

1. Introduction

According to the recent World Energy Outlook (IEA, 2007), if governments around the world continue with current policies, the world's energy needs would be 55% higher in 2030 than in 2005. Energy production and use, particularly of fossil fuels, have a number of environmental impacts including air pollution, greenhouse gas emissions and adverse impacts on ecosystems. According to the latest report from the International Panel for Climate Change (IPCC, 2007), to avoid significant impacts of climate change, global CO₂ emissions should peak before the year 2015 and then decrease by 50 to 85% by 2050 (compared to the year 2000). Key trends observed in Europe include the facts that energy-related greenhouse gas (GHG) emissions remain dominant, accounting for 80% of the total emissions, with the largest emitting sector being electricity and heat production, followed by transport. The intensity of carbon dioxide emissions from public conventional thermal power plants in the EU-27 decreased by about 27% during the period from 1990 to 2005, due to improvements introduced in all Member States. Per capita CO₂ emissions in Greece is estimated to 12 t for 2005 (EEA, 2005 & Eurostat, 2005) (see Graph 1).

Graph 1. CO₂ emissions per capita by country (split by energy and non-energy related emissions), 2005



Source: EEA; Eurostat.

2. Household energy consumption and emissions in E.U and Greece

2.1 Household energy consumption

Household consumption forms an important part of the production-consumption chain as it is consumers who make the final choice of which goods and services to consume. European households affect the environment through their day-to-day choices of which goods and services to buy and how to use them (EC, 2003). Even though the environmental pressures caused by each household are small, compared with those caused by production activities, the combination of millions of European households is a major contributor to environmental problems such as climate change, air pollution, water pollution, land use and waste generation (OECD, 2002 & EC, 2001). Households are one of the largest final energy users in the EU, accounting for 26.2 % of total energy consumption in 2001 (compared with 27.7 % for industrial use) (Eurostat, 2005). Space heating is by far the largest energy end-use in households in the EU-15 (70 %), followed by water heating (14 %) and electric appliances and lighting (12 %) (Enerdata, 2004 & PRIMES, 1999). Space heating absorbs the biggest amount of energy in the residential sector with 71.5% of the total energy consumption in 2004. Consequently, space heating and appliances lightning are highly energy intensive for the examined period and thereupon responsible for the high increasing trend in energy consumption of the residential sector (IEA, 1996).

2.1 Household CO₂-emissions and energy efficiency

The CO₂ emissions per dwelling from the direct use of fuels in households slowly decreased in both the EU-15 and EU-27 over the period to 2005 (by 17% and 23% respectively). The decrease in CO₂ emissions resulted from improvements in the carbon intensity of electricity generation, although the decrease in overall emissions has been lessened by the increase in the number of dwellings in Europe (EC, 2004). The per capita CO₂ emissions from household energy consumption (internal environment and water heating and electric appliances) represent about 10% of the total per capita CO₂ emissions in E.U-27. During the period 1997-2004 total CO₂ emissions -including electricity- have been increased by 20.7% in Greece. In 2004, the most CO₂ intensive sector was households which generate 34.3% of the total CO₂ emissions. The corresponding CO₂ share in 2004 for transport was 23.2%, industry 21.5% and tertiary & agriculture 21%. The total CO₂ emissions (including electricity) per dwelling have increased from 4.87 to 8.43 tonnes of CO₂ / dwelling, namely a growth of almost 73%. The per capita CO₂ emissions from household energy consumption (internal environment and water heating and electric appliances) in Greece represent about 8% of the total per capita CO₂ emissions (CRES, 2006).

3. Household energy consumption and emissions in the region of Attica: Research rationale, content, methodology and results

Aim of this paper, is to present the research results from a random sample of 477 households from the region of Attica. For our research, (contacted in 2008 in the frame of the research activities of the "Environmental Economics" course in the Economics Department of University Piraeus), we used a structured questionnaire,

referring to household patterns and energy consumption practices in the house (internal environment and water heating and electric appliances). Basic objective of our research was the calculation and the analysis of household energy footprint (the total consumption of electric energy and the resultant CO₂ Emissions). For the data input and the footprint calculation, we used the WWF Greece web-based tool (<http://climate.wwf.gr/>) and therefore we applied simple statistical analysis techniques using the SPSS software.

Descriptive statistics from the data for selective variables of interest is shown in Table 1.

Table 1: Household energy consumption and CO₂ emissions statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Household members	477	1	6	3,13	1,280
Household Energy consumption KWh/year	477	719	14027	4503,82	1616,156
Household CO ₂ /year emissions (kg)	477	585	11418	3671,06	1311,247
Per capita CO ₂ /year emissions (kg)				1172,86	
Valid N (listwise)	477				

For the above results, we can draw out the following remarks:

- The household members (**3,13**) differ from those of the 2001 census (**2,8**) and might be quite different for the year 2008 estimations (**2,4**)
- The per household (dwelling) CO₂ emissions (**3,67 t**), are higher than those estimated for the year 2005 in Greece (**2,73 t**), but are less to the EU-27 measures (**4,4 t**)
- The per capita CO₂ emissions (**1,17 t**) are very close to those measured in Greece for the year 2005 (**1 t**) and to the measurements in EU-27 (**1,14 t**)
- The per capita energy consumption (**1.439 KWh**) is almost identical to those measured in Greece for the year 2005 (**1.554 KWh**)

Table 2: Summary of Household and per capita energy consumption and CO₂ emissions statistics

	Greece 2005	EU-27 2005	Our research 2008
Household members	2,8		3,13
Household Energy consumption KWh/year	4351	5700	4503,82
Per capita Energy consumption KWh/year	1554		1439
Household CO ₂ /year emissions (t)	2,73	4,4	3,67
Per capita CO ₂ /year emissions (t)	0,98	1,14	1,17

The number of powered appliances in homes has increased rapidly in recent decades in Greece. Examples include washing machines, dishwashers, microwaves, refrigerators and freezers, and audio-visual appliances such as televisions, DVD players, mobile phones and personal computers. In 2004 energy consumption of electrical appliances & lighting represented 17.8% of the total energy consumed in the residential sector.

The analysis of our data shows that almost half of the households aren't aware of the energy class of their powered appliances and only a small fraction state that are labelled as energy class "A" (see Table 3).

Table3: Household powered appliances energy characteristics

		Class A refrigerator	Class A plate washing machine	Class A cooling air-conditioners	Class A washing machine
		Valid Percent	Valid Percent	Valid Percent	Valid Percent
Valid	Yes	28,9	33,2	29.0	25.0
	No	25,8	22,1	19.4	25.6
	I don't know	45,3	44.7	51.6	49.4
	Total	100,0	100,0	100,0	100,0

Moreover, only 40% switches off the powered appliances disconnecting the power cord. Also, only 21% of the total household lamps are efficient fluorescent lamps (CFLs).

4. Conclusions and proposals

Our research results show, that a remarkable percentage of the households in the region of Attica declare ignorance regarding the energy characteristics of their electric appliances and the majority have low ecological awareness regarding to the management of these appliances. Nevertheless, the household energy consumption in the region of Attica, it's not remarkably differentiated from the medium Greek and European household energy consumption and Carbon Dioxide (CO₂) emissions, as have been shown by other official studies.

According to the EU Directive in energy end-use efficiency and energy services (EEESD), the Member States shall adopt and aim to achieve an overall national indicative energy savings target of 9 % for the ninth year of application of the Directive starting from 2008 until 2017. Consequently Greece must take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target. In Greece the Ministry of Development is responsible for the implementation of the EEES Directive.

Below, there is a series of proposed policies and measures in the household sector, so as to align Greek environmental strategy to the European strategy for the energy and the environment:

Table 4: Proposed National Policies and Measures in the household sector

Measure Title	Measure Type	Subsector	Target Audience	Expected Impact
Energy labelling of domestic electrical appliances	Legislative/Informative	Appliances	general public, landlords, tenants, retailers	High
Inspection standards for central heating boilers	Legislative/Normative	Hot Water, Heating	owner-occupiers, building professions, landlords, tenants	High
Building Energy Efficiency Code	Legislative/Normative	Appliances, Hot water, Heating	owner-occupiers, housing associations, building professions, landlords, manufacturers, retailers	Low
Standards for the thermal insulation for new buildings	Legislative/Normative	Heating	building professions	High
Tax exemption for using natural gas and RES appliances	Fiscal/Tariffs	Appliances, Hot water, Heating	owner-occupiers, housing associations, building professions, landlords, general public, tenants	Low

Measure Title	Measure Type	Subsector	Target Audience	Expected Impact
Efficiency standards for new hot water boilers	Legislative/Normative	Hot Water, Heating	owner-occupiers, building professions, landlords, tenants, manufacturers, retailers	High

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