



Intelligent Energy  Europe



Energy Efficiency Trends of IT Appliances in Households (EU 27)

**Monitoring of Energy Efficiency in EU 27,
Norway and Croatia (ODYSSEE-MURE)**

Fraunhofer ISI]

Karlsruhe, September 2009

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1 Background

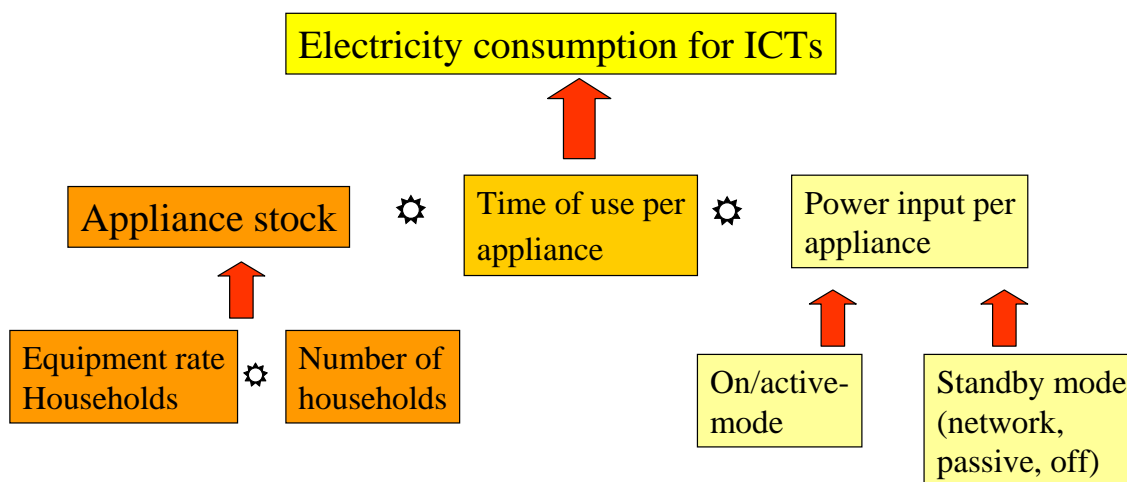
Information and communication technologies (ICTs) represent an increasing part of the electricity consumption in buildings. Alongside the growth in the stock of Information/communication (IT) appliances, new applications and services are constantly being introduced to the market. On top of this, the fixed boundaries between voice, video and data communications are starting to blur and with them also the boundary between consumer electronics and ICT. This convergence of ICT services is described by network and media suppliers under the marketing term "Triple Play Services". This results in demands for the provision of more broadband services both for network access and for fixed lines as well as greater compatibility requirements of end-use appliances. There is a basic trend towards increased computing and memory requirements. These combined developments cause an increase to start with in the energy demand for ICT applications. On the other hand, technology dynamics, which still adheres to Moore's Law, produces a large potential for energy saving which is being discussed under the heading "Green IT". There is a need to reconcile these two developments. Against the background of sustainable development being based on a balanced use of resources, ICT should be used with the goal of energy and resource conservation and, at the same time, should be designed to be energy- and resource-efficient in the sense of Green IT.

An important precondition for Green IT activities is a good knowledge on the energy consumption of IT equipment. At the moment, however, there are only limited data on the electricity consumption for IT appliances both at the level of the EU and single Member States. Therefore, new indicators for IT appliances have been developed within the ODYSSEE database in order to provide more detailed information on the electricity use of IT appliances.

2 Methodological Approach and data sources

A computational model is used to determine the current and future power demand for ICT applications which includes the following demand-determining components: the stock of appliances for each product group, the average power input of the products and applications in the different operating modes¹ and the respective time of use (Figure 2-1).

Figure 2-1: Model to calculate the electricity consumption for IT appliances in the ODYSSEE database



IT appliances in households comprise a wide range of appliances: audio-visual devices such as compact systems, TVs, set-top-boxes, DVD player or video game consoles, computers and peripherals (screens, printers, scanners etc.), telephones and the whole communications infrastructure. As a starting point, not all these IT appliances have been included in the ODYSSEE database, but only the most important ones with regard to energy consumption or appliances with an increasing consumption trend. The following IT appliances have been selected (Table 2-1):

- **Televisions** (highest share in consumption; TVs were already included in the Odyssee database before, though not all countries could deliver data on energy consumption)
- **Set-top boxes** (strongly increasing energy demand due to digital TV etc.)
- **Computers** (increasing consumption trend in normal mode)
- **Monitors** (technological change, increasing screen size)
- **Routers** for internet connection (increasing energy demand in households)

¹ On or active mode and standby mode (including: network-standby, passive standby, off-mode, off)

For all these appliances, the following variables are calculated (Table 2-1):

- Number of households
- Ownership rates of appliances
- Appliance Stock
- Time of use of the appliances
- Power input in different operation modes
- Total energy consumption and unit consumption of the appliance stock.

Table 2-1: Data structure of IT appliances in the ODYSSEE database

Appliance Type	Variables	Available by country	Data Source
TV set	Number of households	Yes	Odyssee Database
Set-top-box	Ownership rate appliance	Yes	Odyssee Database, Eurostat ICT Database
Desktop PC	Appliance Stock	Yes	Calculated [Number of hh * ownership rate]
Laptop PC	Time of use	No (only EU average)	Studies (EuP, Fraunhofer IZM/ISI)
CRT monitor	Power (active and standby mode)	No (only EU average)	Studies (EuP, Fraunhofer ISI/FfE, Fraunhofer IZM/ISI)
LCD monitor	Energy consumption stock	Yes	Calculated [Appliance Stock * Time of use * Power]
Router	Unit consumption stock	No (only EU average)	Calculated [Watt*time*365/1000]

Whereas data on the number of households, the ownership rates and the resulting (calculated) appliance stock could be collected by country, for the technical and behavioural parameters (time of use and power input) EU average figures had to be used there are only a few data available at the level of individual countries. But since the IT appliances sold are almost the same all over Europe, the average power input per appliance should not differ too much between the individual countries.

The main data sources for the variables included in the ODYSSEE database for IT appliances are shown in Table 2-1. With regard to the appliance stock, the number of households and ownership rates for televisions could be taken from the ODYSSEE database. For the other appliances, the ownership rates were taken from the EUROSTAT statistics on the information society, which collects data on the usage of Information and Communications Technologies (ICTs) in all EU Member States on a yearly basis. The statistics was built up since the beginning of the 2000s, for most of the countries, data are available since 2004². There are, however, data gaps for some countries both in the ODYSSEE database with regard to equipment rate for TVs and in the EUROSTAT ICT database for the other IT appliances, too. In addition, the multiple equipment with some of these appliances cannot be taken into account sufficiently. In the ODYSSEE database, some countries provide equipment rates for TVs >100 % which include the existence of 2 or more TV sets in some households, other countries

² In spring/summer 2009, most of the data were only available up to 2006.

only provide data on the general existence of (one or more) TV in a household. The same applies to the EUROSTAT ICT database, which is based on a household survey which asks for the general availability of an appliance, and not on the real number.

The data on the time of use and the power input were mainly taken from the EuP Preparatory studies on these appliances (EuP Lot 3-7) and from two German studies (Fraunhofer IZM/Fraunhofer ISI 2009³; Fraunhofer ISI et al. 2005). Whereas the energy consumption data in the EuP studies and the study by Fraunhofer IZM/Fraunhofer ISI represent the state from 2006/2007, the study from Fraunhofer ISI et al. also includes power input data for former years (2001, 2004). In order to get at least short time series for the new ODYSSEE indicators on IT appliances, these data were used. Missing years were interpolated. It must, however, be pointed out that these time series on the power input of the appliances are not fully compatible due to different data sources and different methodological approaches used in the studies.

³ In this study, most of the data on the usage and power input of IT appliances were also taken from the EuP Preparatory Studies (Lot 3-7).

3 Results

In the following, the development of the new indicators on IT appliances in households is shortly described. The detailed data and time series are included in a separate Excel file which is provided in addition to this report.

Equipment rates and appliance stock

The appliance stock was calculated by multiplying the equipment rates with the IT appliances taken into account with the total number of households in each country. As an example, Figure 3-1 and Figure 3-2 show the household equipment with set-top-boxes and the share of household with internet connection (as a proxy for the number of routers). For both appliances, a considerable increase could be observed in almost all countries.

Figure 3-1: Development of the equipment of households with set-top-boxes by country (2004-2006)

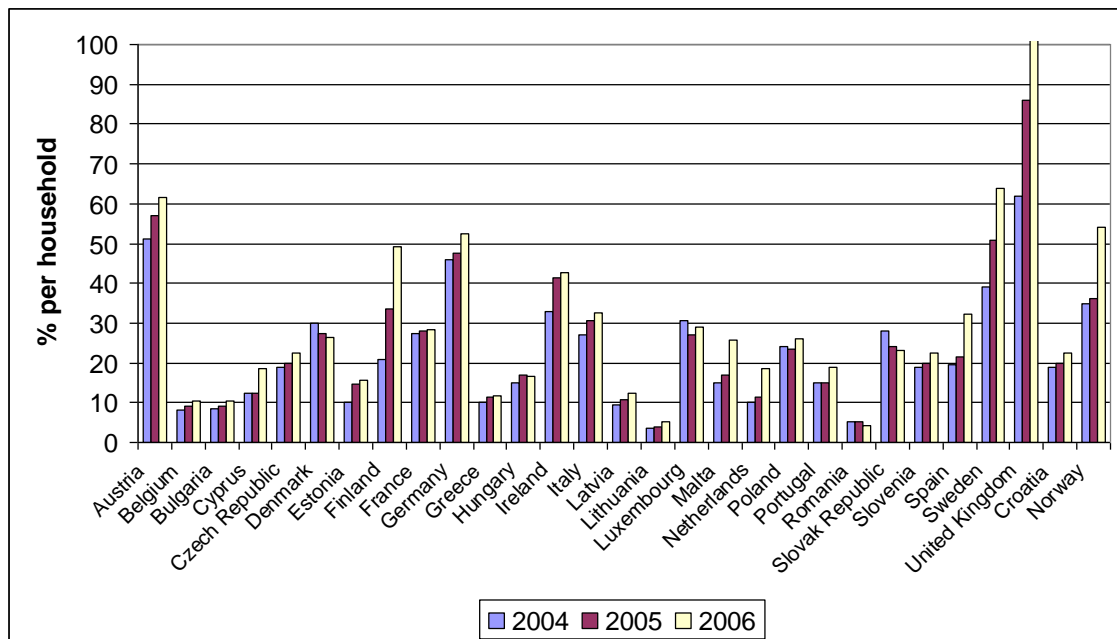


Figure 3-2: Percentage of households with internet connection (2004-2006)

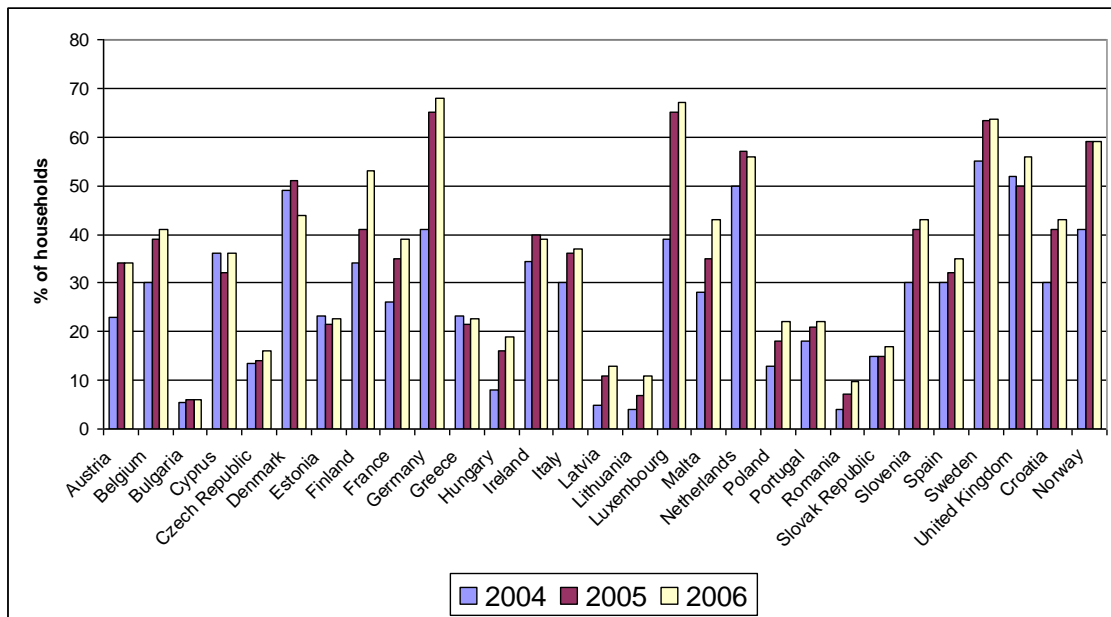


Figure 3-3 shows the resulting development of the appliance stock in all Member States, Norway and Croatia between 2004 and 2006. All IT appliances apart from CRT monitors show an increasing development in most of the countries.⁴

Time of use

The assumptions on the time of use have been taken from the EuP case studies and from a study by Fraunhofer IZM/Fraunhofer ISI (2009). Since there are only a few data available at the level of individual countries, the assumptions are the same for all countries (Figure 3-4).

⁴ The decreasing stock for TVs in 2006 is due to data gaps for some countries in the ODYSSEE database: some countries did not deliver data on equipment rates for TVs and/or the number of households for 2006 (and partly earlier years) at the time when the IT indicators were calculated (based on the state of the ODYSSEE database in November 2008).

Figure 3-3: Development of the number of IT appliances in EU Member States, Norway and Croatia (2004-2006)

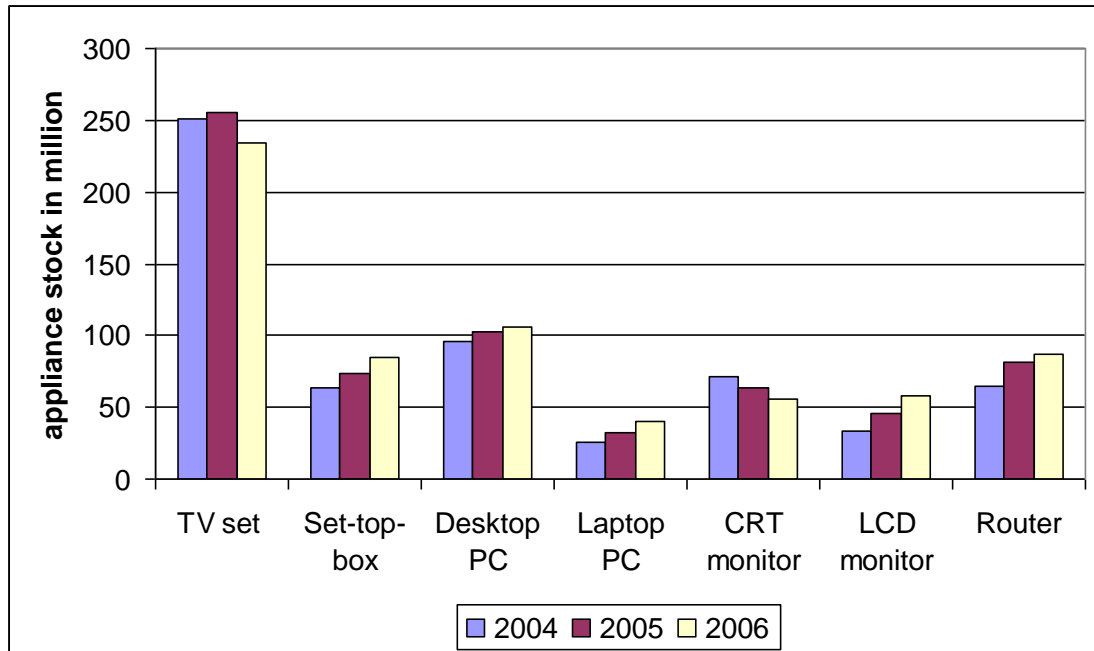
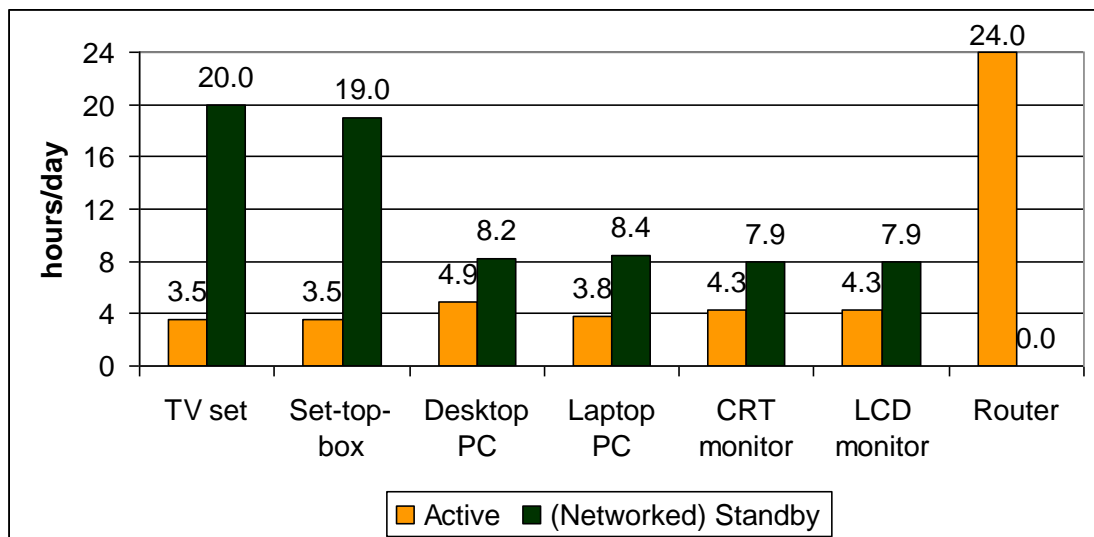


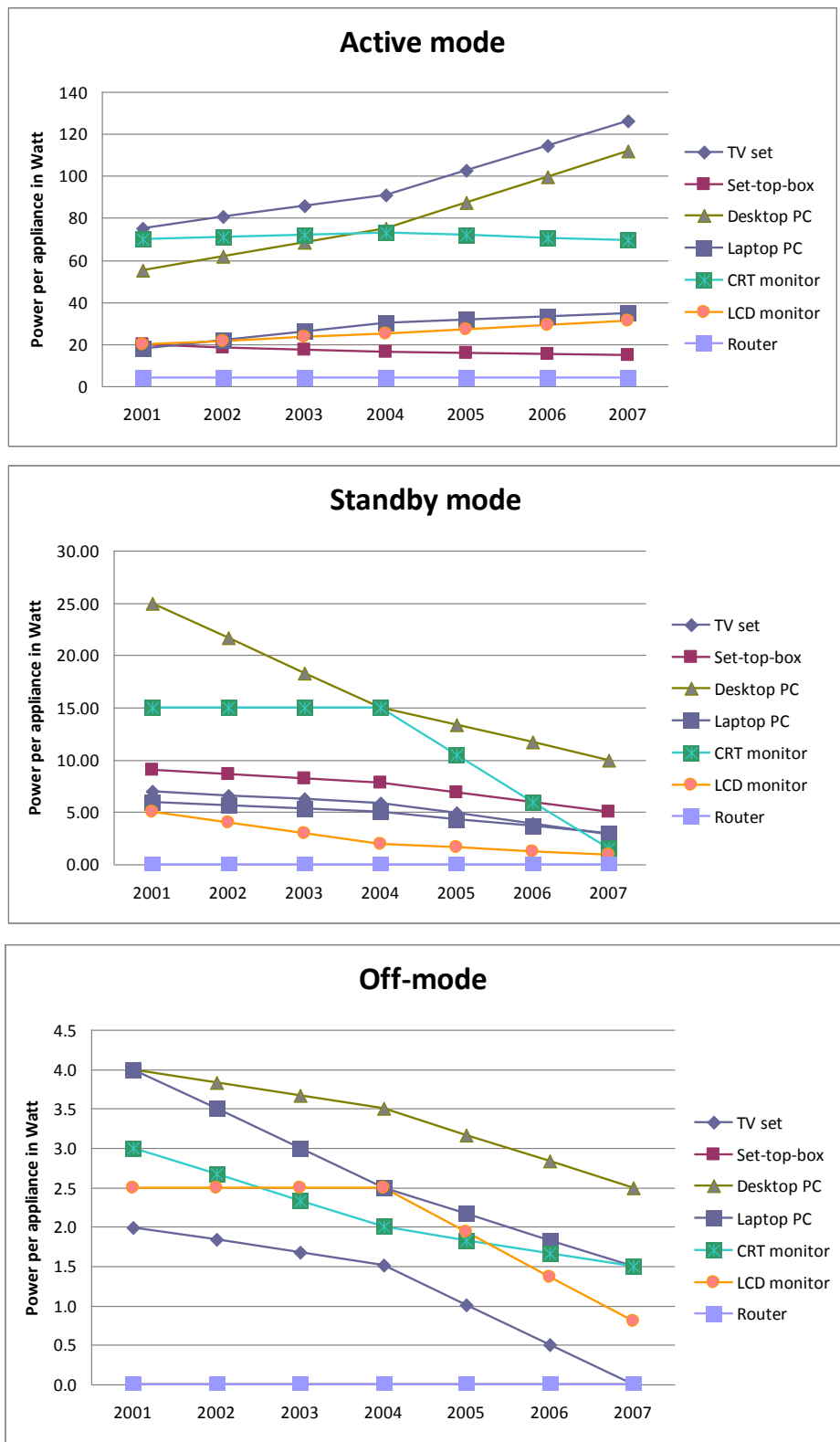
Figure 3-4: Time of use by type of appliance (all years)



Power input

The same applies to the power input in the different operation modes. Here, an EU average is taken for all countries (Figure 3-5). Whereas the power input in the standby and off-mode shows a falling trend, there is an increase in active mode for most of the IT appliances.

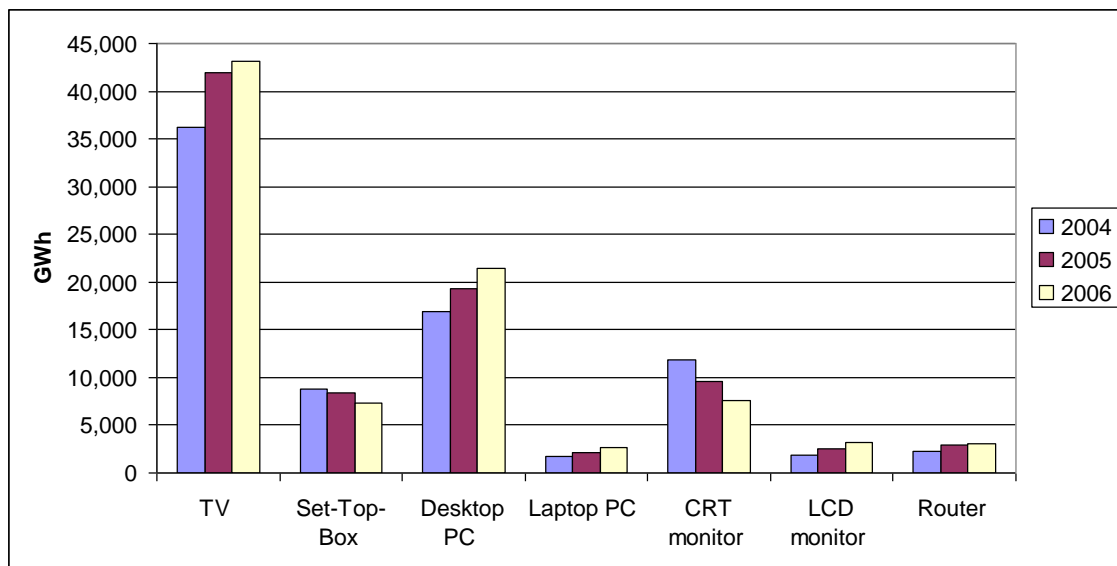
Figure 3-5: Power input by operation mode and type of appliance 2001-2007



Total electricity consumption and unit consumption of the stock

The total electricity consumption of the six IT appliances in households which are distinguished in the ODYSSEE database is shown in Figure 3-6. In 2006, the total electricity consumption of these appliances amounted to around 88.3 TWh⁵. The most important energy consumers are the TV sets, followed by Desktop PCs.

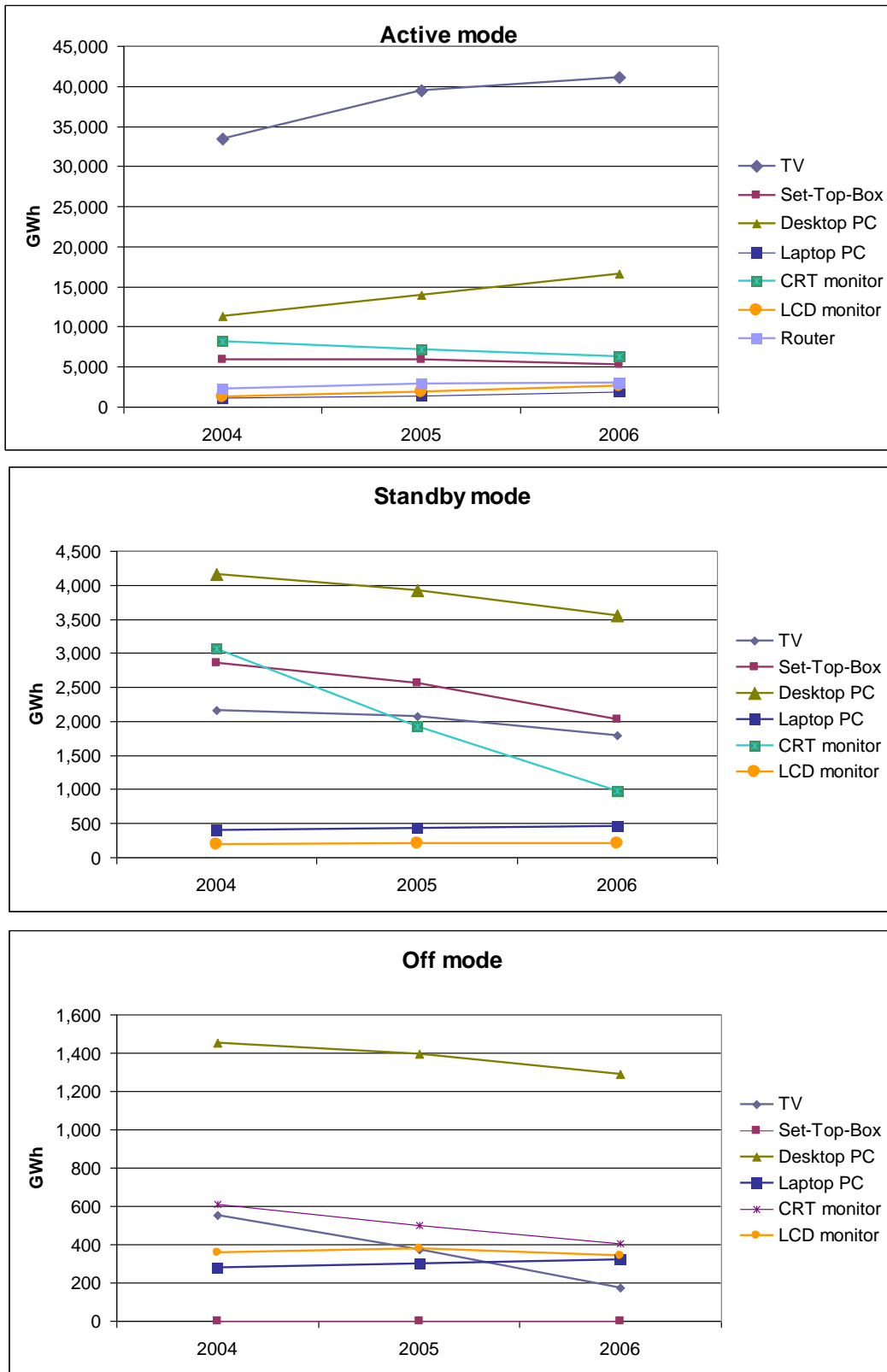
Figure 3-6: Total electricity consumption of IT appliances (EU-27, Norway, Croatia)



The development of electricity consumption in the three operation modes distinguished here is different. Whereas energy consumption in active mode shows a rising trend at least for TVs and desktop PCs, the consumption in standby and off mode is decreasing or at least constant.

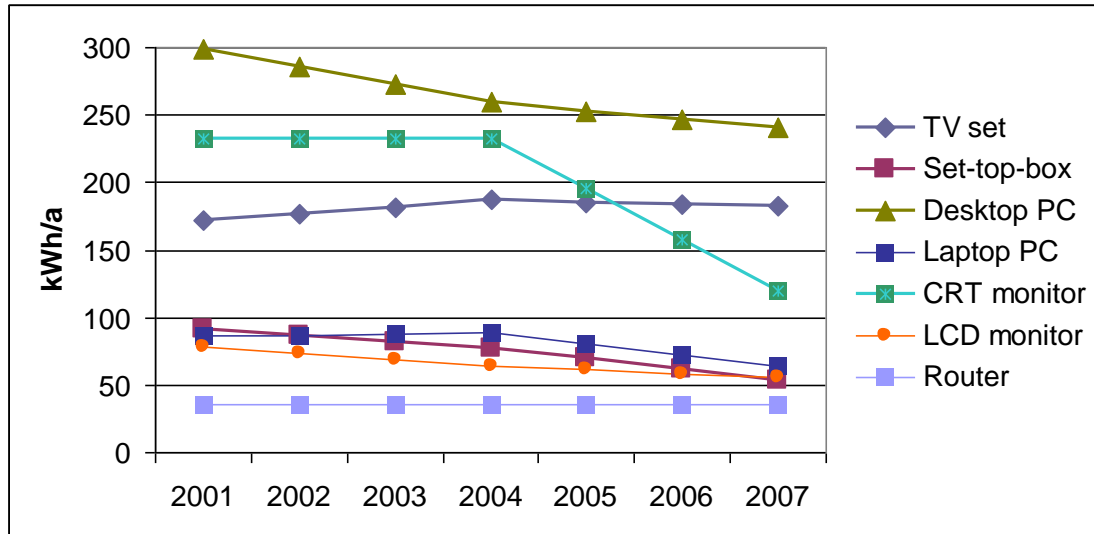
⁵ Not included: some countries for which the appliance stock for some appliance types and/or some years could not be calculated due to data gaps in the ODYSSEE database or in the EUROSTAT ICT database.

Figure 3-7: Total electricity consumption in the different operation modes



Total unit consumption of the IT appliances in all operation modes is shown in Figure 3-8. Most of the appliances show a slightly decreasing trend since 2004. For TVs, however, a further increase is observed which is mainly due to the increasing screen size, though the share of the more energy-efficient LCD technology, which more and more substitutes the former CRT technology is growing.

Figure 3-8: Total unit consumption by appliance (all operation modes) 2001-2007



4 Outlook

A regular collection of data and indicators on the energy efficiency of IT appliances would be useful since these appliances become more and more important for energy consumption in residential buildings. The regular EUROSTAT survey on the equipment of households with IT appliances is a suitable data source for data on the appliance stock which is available by year and – in a homogenous manner – for all EU Member States. The data gaps for some countries will probably become smaller in the coming years.

Data on the time of use and power input of IT appliances are more difficult to collect, even if only EU averages are used and not individual data by country. The EuP Preparatory studies which have already been carried out for all important IT appliances formed a very valuable data source, but only for one point in time. In order to collect complete time series, which are necessary for an evaluation of energy efficiency by indicators, a continuation of these efforts would be necessary. Otherwise, the collection of complete and compatible time series on energy consumption of IT appliances within the ODYSSEE database will remain difficult in future.

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