Energy and Buildings 58 (2013) 355–362

Contents lists available at SciVerse ScienceDirect

Energy and Buildings

journal homepage: www.elsevier.com/locate/enbuild

Assessing the market for air conditioning systems in European buildings

Roger Hitchin[a,*], Christine Pout[a], Philippe Riviere[b]

[a] BRE, Watford WD25 9XX, United Kingdom
[b] MINES ParisTech, Center for Energy and Processes – CEP/Paris, 60, Bd Saint Michel, Paris 75006, France

ARTICLE INFO

Article history:
Received 28 May 2012
Accepted 2 October 2012

Keywords:
Air conditioning
Market diffusion
Stock
sales
Europe
Energy policy

ABSTRACT

This paper models the past and future sales, replacement rates and installed stock levels of air conditioning products in Europe. Established market diffusion models have been reformulated to allow their calibration against product sales data, and then used to estimate future and past sales levels, time-dependent product replacement rates and installed stock levels in each EU-27 country for each of the major energy-using air conditioning products. The results show that, for most air conditioning products, continuing growth of sales and stock is to be expected, albeit at lower rates than in previous years. Expressed in terms of kW cooling power, split-system room air conditioners and chillers continue to account for the majority of sales and stock, with variable refrigerant flow (VRF) systems taking an increasing share of first-time installations. The results provide fundamental information on which to base policy assessments (which are not part of this paper).

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

In Europe, the ownership and electricity consumption of air-conditioning in buildings has been increasing for several decades. Assessment of the extent to which these trends will continue is central to the development of policies to ameliorate the environmental and energy security consequences. Also important is the rate at which existing products will be replaced, potentially by those of higher efficiency.

This paper describes and applies procedures for estimating future levels of new and replacement sales, and installed stock. These were developed for use in Preparatory Studies for air conditioning systems and products in support of the application of Eco-design Directive [1,2]. This paper does not address energy consumption per se: it provides a foundation for such assessments.

"Air-conditioning in buildings" here means air-conditioning systems whose primary purpose is to provide comfort for people: "comfort cooling" rather than cooling to support, for example, cold storage, IT equipment or industrial or other processes.

2. Air-conditioning products and systems

There are three broad categories of air-conditioning "systems" which are used for comfort cooling, some of which are self-contained products. To varying degrees, each of the following categories itself contains several types of product.

1. *Moveable units* – appliances bought over the counter or through Internet suppliers and not generally requiring any installation expertise.
2. *Fixed room air conditioners/packaged systems* – series-produced self-contained units or systems comprising a unit that conditions a single room and designed to be installed professionally.
3. *Central systems* – larger systems that serve more than one room (often large numbers of rooms). They are generally bespoke systems designed for specific buildings, but are largely composed of standardised component products.

All three types of systems are used in both residential and commercial/public buildings, albeit to different degrees. In Europe, central systems are overwhelmingly found on non-residential buildings, most moveable units are used in dwellings and fixed room air conditioners are used in both market sectors.

3. Functional units

Each of the categories of air conditioning system is more or less appropriate in different climates and building types. The choice is also influenced by whether a product or system is for installation in an existing building, in a new building or is a replacement for an existing system (or part of a system). In order to represent the market as a whole it is necessary to use a functional unit that can accommodate all these systems.

* Corresponding author. Tel.: +44 1923664773; fax: +44 1923664097.
E-mail addresses: hitchinr@bre.co.uk (R. Hitchin), poutc@bre.co.uk (C. Pout), philippe.riviere@mines-paristech.fr (P. Riviere).

0378-7788/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.enbuild.2012.10.007

The logical functional unit is the nominal cooling capacity. This unit allows the different systems and products, and the different cooling capacities of otherwise similar products to be combined into a single market metric that represents the principal functional requirement. The unit does neither distinguish between systems that differ in their provision of other functions, such as humidity control, or air filtration; nor does it distinguish differences in preference for different end-uses or climate. These aspects can be addressed in terms of competing products within different market sectors.

Central air conditioning systems usually also provide mechanical ventilation and, in addition, may distribute cooling in the form of re-circulated air. The energy used to provide this ventilation and air circulation can be considerable. As a result the maximum amount of air that an air handling unit can handle is an additional functional unit.

4. Estimation methodology

4.1.1. Required outputs

Because different countries have different climatic, economic and market conditions it is necessary to consider each country separately. The summary results in this paper are mainly at an EU-27 level, which has been aggregated from figures for each Member State.

Within each country the residential and non-residential sectors may have differing market dynamics and are modelled separately. In principle, different parts of the non-residential sector may also differ, but there are insufficient data to disaggregate the modelling to this extent.

The purpose of the modelling procedures is to represent medium and long-term underlying trends that are relevant to policy decisions, rather than the short-term market forecasting which would be of operational interest to manufacturers and installers. The required outputs from the processes are annual (or perhaps 5-yearly) estimates of:

- installed stock of air conditioning systems, preferably broken down by type of systems and end-use – at least for the major categories; and
- sales of systems or major components of systems, ideally broken down into first-time installations in new buildings, first-time installations into existing buildings, and replacements.

4.1.2. Choice of methodology

Our choice of methodology is influenced by two significant practical considerations

- the data available are limited; and
- a desire to use parsimonious methods which provide adequate information with the minimum of complication.

The most extensive (and often the only) data available are for product sales, collected for market research purposes. In consequence, our basic analysis philosophy is to estimate stock from sales data. This requires the estimation of product lifetimes and, for markets which have not yet reached saturation, to estimate future sales (and historical sales for periods earlier than the available data). This is the case for European markets.

With the functional unit described above, air-conditioning is an example of a product (or service) without closely competing alternatives. The workhorse model for the market diffusion of products without closely competing alternatives is the Bass model [3]. This has been successfully applied to describe the market diffusion of many types of products and innovations, including air conditioners in the USA. A disadvantage is that it requires the estimation of four parameters:

- the ultimate market potential: the number of products that will eventually be in use;
- a reference date, which may be the start of a market or the date of peak sales;
- a coefficient of innovation (or external influence). This reflects the inherent propensity of potential purchasers to acquire a novel product irrespective of whether other purchasers have done so; and
- a coefficient of imitation. This reflects the influence of the existence of existing purchasers on the propensity to purchasers.

Our basic modelling philosophy is to fit market diffusion curves to historic national sales data and to use these to estimate future sales. Sales data are generally available at a national level and so this represents a practical level of geographical disaggregation. Some of the parameters are likely to vary with GDP per capita or climate, and national disaggregation allows this to be reflected (albeit not at a sub-national level). Our basic approach implicitly assumes that underlying historical trends in GDP and market structure will continue in the future and can be represented by a continuation of the modelled time series. Adjustments for GDP are discussed later.

Sales figures include products and systems that provide both

- growth of the market (installation in new buildings and first-time installation in existing buildings); and
- replacement of existing equipment (or systems).

The basic form of the Bass model includes only the first of these, so estimates are also needed of replacement sales. This, in turn, requires estimation of a further parameter – the average life of a system or product.

The available sales data do not cover all Member States and extend back in time at most for only about 18 years – and often only for shorter periods. This is shorter than the lifetime of many air conditioning systems, and the six decades or so for which the market has existed, so backwards estimation of sales is required.

Most previous studies of air-conditioning market structure have focused on applications in dwellings. The market drivers for tertiary buildings may be different and simply applying models based on the residential market may lead to misleading results. Because of this and the differing availability of data, we have developed different variants of the procedure to estimate sales and stock figures for small (<12 kW cooling capacity) single-room air conditioners, and larger more complex systems.

5. Modelling the sales and stock of single-room air conditioners

5.1. Scope

This market sector includes both fixed and movable systems. The majority of European air conditioning in dwellings is provided by single-room systems, though there are actually more sales (and existing stock) of such systems in tertiary buildings. For regulatory purposes products of up to 12 kW cooling capacity are considered “domestic” most products sold are considerably smaller than this.

Download English Version:

https://daneshyari.com/en/article/263549

Download Persian Version:

https://daneshyari.com/article/263549

Daneshyari.com