Potentials for Energy Efficiency in the Swedish Commercial and Service Sector by End-use forecasting using EXCEL and EPRI-COMMEND.

Heini-Marja Suvilehto and Randall Bowie

1. SYNOPSIS

This poster paper describes our methodology for end-use forecasting of the Swedish commercial and service sectors.

2. INTRODUCTION

NUTEK's Department of Energy Efficiency (DOEE) divides energy users in different sectors; these are the transport, industrial, residential and commercial sectors. DOEE's energy efficiency programmes include, e.g. (TP), technical procurement and general incentive agreements. This paper will discuss if DOEE's programmes in the commercial sector can be evaluated by using an end-use forecasting model.

Our aim is to estimate the future energy use levels in the Swedish commercial and service sector and what effects DOEE's programmes can have on future energy use in commercial buildings. Our analyses are made by comparing different forecasting scenarios.

One of the scenarios, where there is no DOEE programmes, is the base-line. Other scenarios are reference cases where all the different programmes or methods are studied one by one and in combination with each other, so that different policies for energy use improvements can be investigated. Effects of TP can be analysed separately or with a scenario that includes both TP and other policies.

Our analyses are made by using the EPRI-COMMEND model1,2 which is a specific model for the commercial sectors energy use. COMMEND is combined with EXCEL spreadsheets, so that different technologies for an end-use can be compared to each other. This is of importance as TP tends to focus attention on specific technologies within an end-use market and there by stimulate and increase competition.

The main difference between our analyses and those made before is the way in which the forecast tool COMMEND is used, especially its detailed lighting module, which provides an even higher level of disaggreation than is normally used in conventional break-downs of end-uses. Furthermore, technology in our model is composed so that all technologies are so up to date as possible and all the technology options which are of present or future interest for the DOEE are taken into account.

3. PROGRAMMES

The DOEE has special programmes for the following seven building types in the service and commercial sector: offices, health care, stores, education, sport facilities, storage buildings, meeting halls, hotels and restaurants. These programmes include five end-use technologies: lighting, ventilation, climate cooling, office equipment and refrigeration in food shops.

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[1]EPRI-COMMEND model is a specific end-use planning and forecasting model for the service and commercial sector. It can be used for long-run forecasting, integrated planning and DSM planning. The model structure is a maximum 10 end-uses and 20 building types. The software is developed by Regional Economic Research Inc. San Diego, California, USA for EPRI, Electric Power Research Institute, Palo Alto, California USA.

[2]Commercial end-use forecasting in Sweden using EPRI-COMMEND 3.2 by SRC International ApS, 1994.

4. METHOD

Most of the DOEE's programmes are implemented at a very disaggregated level. TP, e.g. is often a component in an end-use technology, such as the High Frequency Electronic Ballast (HF), which was a TP programme in lighting. Other working methods for the DOEE are the special performance requirements, which are voluntary standards. These requirements are adjusted to the functional use of the space, which very often is the same as a room type. The desired level of disaggregatation for the DOEE is that of different components and functional spaces. Since these cannot be analysed in COMMEND, EXCEL spreadsheets will be used so that details at these levels can be provided, while the more aggregated data resulting from the spreadsheet is used as input in the COMMEND model. Which data will be used in both of the programmes and what is the output of each programme is discussed below and shown in the flow chart.

5. SEGMENTATION

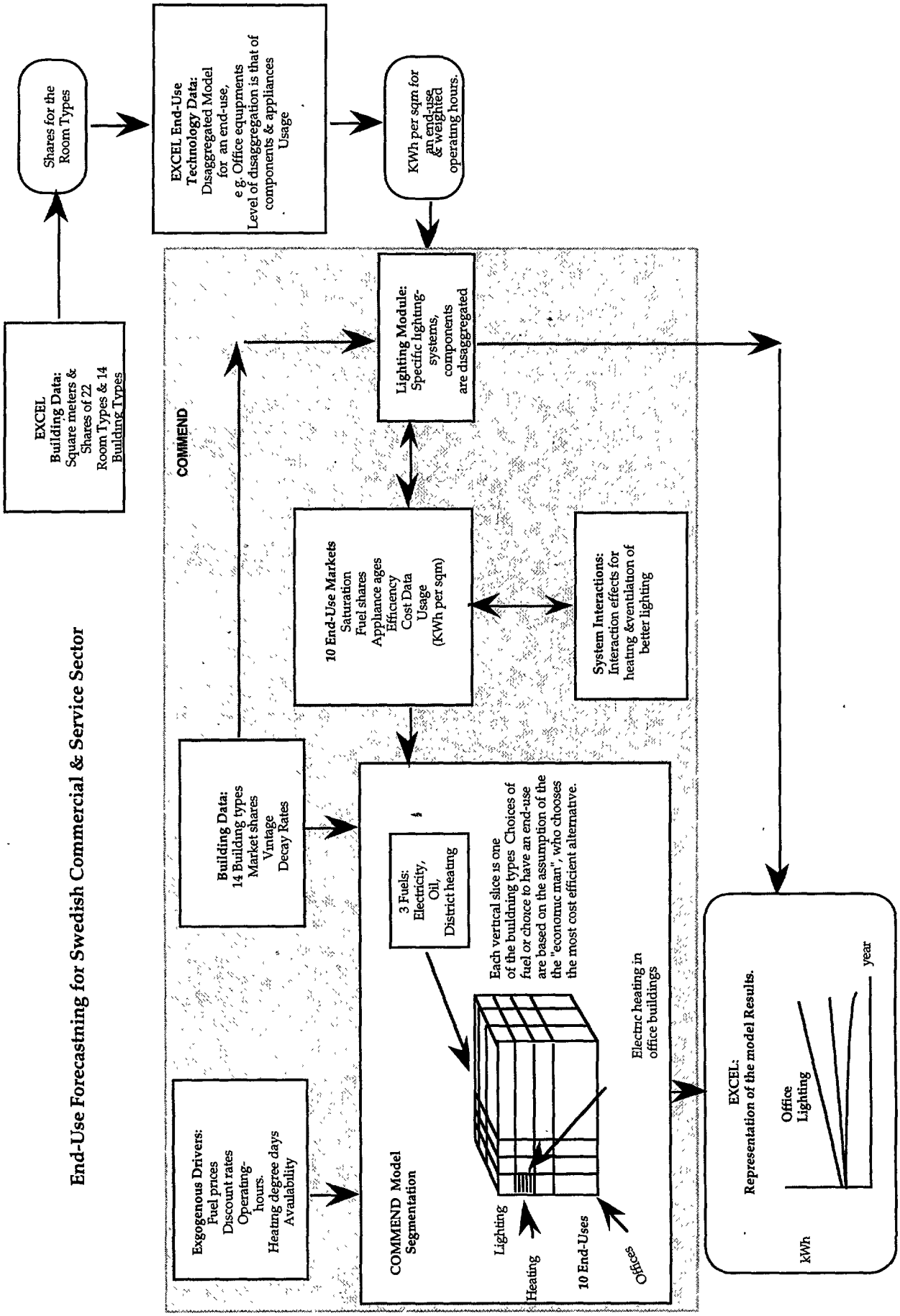
The Swedish service sector is segmented into 14 building types and 10 end-uses, and this segmentation is available in COMMEND. It would be more interesting to use a segmentation based on the functional use of the space rather than the building type for some of the end-uses such as lighting and office equipment. Lighting as an end-use differs in one building type with respect to the different functional areas of the building, the illuminance levels (lux) and the operating hours. Indeed these are quite different for corridors and office rooms.

EXCEL is used for the building types so that each one of the 14 building types can be divided into 22 room types. The results are either in square meters or as percentage of each room type in each building type, e.g. offices buildings are to 48% office rooms and to 31 % corridors. The data over the functional space in each building type gives the magnitude of the DOEE's performance requirements, discussed in page one.(This data comes from Vattenfall's "STIL"-project, which was a statistical energy audit study of the commercial sector.) The percentage of all the 22 room types can be used to give weighted, operating hours for those end-uses that have different operating hours in different room-types. For the weighted operating hours we assume that each room type is used similarly in all the building types, e.g. an office room is used similarly in office buildings and in schools.

The end-use technology is analysed first in the EXCEL and then these results are used in COMMEND as inputs for scenarios. Modelling with EXCEL is necessary as the end-use technology is represented in COMMEND as shares of an average and a marginal energy-use index (EUI) expressed in kWh per year within an end-use market and building type. The EXCEL modelling will give us the different annual energy-uses and technology curves for the following four end-uses: ventilation, climate cooling, refrigeration in food shops and office equipment.

In the latest version of COMMEND, there is a lighting module where different lighting systems can be analysed. This is an excellent way to analyse HF, the TP programme named above. The COMMEND's lighting module uses room factor and "lux", lighting levels, to produce energy usage in lighting. They are the same for the whole building as the area comes from floor stock input data in COMMEND, where segmentation is done by building types. EXCEL is used here to produce shares and operating hours for each lighting system and percentage shares of functional spaces in a building type.

Some of the policy options available in COMMEND cannot occur in Sweden, either because there is legislation against the policy or it is not cost efficient. Such a policy is, e.g. the change of a less efficient magnetic ballast to a better HF. The high labour cost in Sweden means that when a bigger replacement or retrofits are made then the whole fixture is to be changed. In COMMEND the technology should be cost efficient, the technology choice is based on the Life Cycle Cost, LCC. Sometimes the technology choice is made for other reasons than the LCC, which are more difficult to analyse. The new technology may give a better environment in the building for those who work there, and it may give higher productivity and less absenteeism among the employees. These factors however cannot be measured in these models.


End-Use Forecasting for Swedish Commercial & Service Sector
EXCEL
Building Data:
Square meters &
Shares of 22
Room Types & 14
Building Types
Shares for the
Room Types
EXCEL End-Use
Technology Data:
Disaggregated Model
for an end-use,
e.g. Office equipments
Level of disaggregation is that of
components & appliances
Usage
KWh per sqm for
an end-use
& weighted
operating hours.
COMMEND
Lighting Module:
Specific lighting-
systems,
components
are disaggregated
10 End-Use Markets
Saturation
Fuel shares
Appliance ages
Efficiency
Cost Data
Usage
(KWh per sqm)
System Interactions:
Interaction effects for
heating &ventilation of
better lighting
Building Data:
14 Building types
Market shares
Vintage
Decay Rates
3 Fuels:
Electricity,
Oil,
District heating
Each vertical slice is one
of the buildning types Choices of
fuel or choice to have an end-use
are based on the assumption of the
the "economic man", who chooses
the most cost efficient alternative.
Electric heating in
office buildings
Exogenous Drivers:
Fuel prices
Discount rates
Operating-
hours.
Heating degree days
Availability
COMMEND Model
Segmentation
Lighting
Heating
10 End-Uses
Offices
EXCEL:
Representation of the model Results.
Office
Lighting
kWh
year