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Renewable energy from heat pumps
- a note on the Danish implementation of EU guidelines of statistics

Introduction

In this note it is described how the Danish Energy Agency calculates the production of renewable energy from heat pumps. The purpose is briefly to document the main principles and to encourage discussion on the method.[1] Heat pumps installed in e.g. dwellings and office buildings are described below, but not the larger heat pumps designed to produce district heating.

The Danish Energy Agency follows the statistical guidelines established in Decision 2013/114 from the EU Commission. According to these guidelines, renewable energy from heat pumps is defined as

> The amount of useable energy from heat pumps (typically heat in buildings) minus the amount of energy (electricity) used to run the heat pumps

In the guidelines, it is assumed that the stocks of various types of heat pumps are known. The annual renewable energy from heat pumps is calculated as a function of the stock of heat pumps and parameters such as the yearly hours of operation and the efficiency of the pump. The values of the parameters are proposed in the EU-guidelines, and members states are assumed to use the proposed values, unless better estimates are available.

In symbols, the calculations are as follows: Q is “useable” energy, that is, the energy that can actually be used to heat the house, e is electricity used for the heat pumps, E is renewable energy, H is hours of operation, P is stock of heat pumps (capacity in energy units), and ε is efficiency

$$Q = H \cdot P$$
$$Q = \varepsilon \cdot e$$
$$E = Q - e$$

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The main statistical problem is to estimate the stock of the heat pumps, P.

Estimation of the stock of heat pumps

Since 2013 the Danish Energy Agency has been using two data sources:

1) Heat pumps installed (stock statistics)
Installation of heat pumps registered in the building register, though not for all heat pumps.

2) Annual sale of heat pumps (flow statistics)
For all types of heat pumps, sales statistics are available and have been for a number of years. Sold heat pumps are classified by type and capacity.

In the building register a heating technology is recorded for each building. If the technology is "heat pump", we assume that the type of heat pump recorded is either "water to water" or "air to water", that is the "large" heat pumps meant to heat every room of a house and to supply hot water for domestic use. Hence, the Danish Energy Agency uses **the building register to measure the stock of "water to water" and "air to water" heat pumps**.

The building register only includes the "primary" heating technology for each house. Many types of heat pumps are used as supplement and these are therefore not recorded in the building register. For these types of heat pumps, the Danish Energy Agency uses sales statistics.

To estimate the stock of heat pumps from annual sales, it is assume that heat pumps are in function for 10 years. If the type is "air to air", the heat pump is assumed to exist for 20 years. Hence the **stock of heat pumps is** $P_t = S_{t-1} + S_{t-2} + \ldots + S_{t-10}$ **or** $P_t = S_{t-1} + S_{t-2} + \ldots + S_{t-20}$, where S is annual sales and subscript denote year.

Discussion of method

Ideally, renewable energy from heat pumps should be calculated by measuring the amount of energy that comes out of all heat pumps in Denmark.

In practices, however, the only "truly statistic" measure used above is the number of installed or sold heat pumps, whereas a range of parameters necessary to calculate renewable energy are standard values, especially hours of use,

efficiencies and life times for heat pumps. This means that for example that a calculated increase in RE from heat pumps cannot reflect variations in these parameters.

Discussion of the used and alternative data sources for stock of heat pumps

The disadvantages of using the building register are that

- Only “primary” heating technology is recorded
- Even recording of primary heating is imprecise and underestimate the number of heat pumps. This is because the house owner shall report e.g. a replacement of oil with a heat pump, but often neglect to do so.

There are certain opportunities to increase the precision of the register, and these will hopefully be implemented in the years to come.

The disadvantages of sales statistics are that

- Calculations of stock of heat pumps require assumptions of the scraping of existing heat pumps.
- The sales statistics is reported by importers and manufacturers of heat pumps who are members of two business associations. These importers and manufacturers do not cover the whole market.

As a possible alternative, surveys of households can be carried out. Households can be asked what heating technologies that are installed in their homes. The disadvantages of surveys are:

- They are costly
- Few respondents cause statistical uncertainty. This means that e.g. an increase of renewable energy from heat pumps from one year to the next may be due to statistical uncertainty.
- Non-response may be systematic