# Quantify the benefit

The quantification of the benefit caused by energy saving measures is oftentimes a challenge for its own. Especially the influence on the energy consumption for heat demand is oftentimes hard to quantify.

**Integral measurements:** A very good indicator of energy consumption is a frequent recording of the gas meter. Modern gas meters in the Netherlands, as well as modern gas boilers, allow daily or sometimes even hourly measurement of gas consumption and display of this data in a web interface. Drastic events such as turning on the heating to raise the room or house temperature or lowering the temperature during vacation can be easily monitored. Leaving a window open over a large radiator for a long time can also be detected. However, the data is difficult to interpret because energy consumption for heating depends not only on the desired room temperature, but also on the changing outdoor temperature. Correlating energy consumption with outdoor temperature is a common method and shows a near linear correlation between the two variables.

**Calculations:** When it comes to smaller energy saving measures, the direct effect on gas consumption is hardly visible. In these cases, a typical engineering approach is to calculate the energy savings based on given data or estimates.

**Example: Energy cost of using the cooker hood**

What are the operation cost in terms of energy "loss" of a cooker hood with an outside exhaust and without any heat recuperation? To answer this question, we first look at the mass balance of air inside the house. A standard cooker hood ventilates roughly 150m³/h of air to the outside. As the total amount of air is constant in the house, cold air of ambient temperature will enter the house. Note, houses are never 100% tight. The heat capacity of air is 1.005 kJ/(kgK) and the density of air is around 1.2kg/m². For each degree difference between the inside and outside temperature, the operation of the cooker hood will cause a net heat transfer of 150m³/h*1.2kg/m²*1.005 kJ/(kgK) = 180.9 kJ/K/h.

In order to express this in a common way, e.g. in the unit kW, we have to change the unit hour (h) in seconds, thus multiplying the denominator by 3600. The power is then 0.05 kW/K. On a cold winter day at -10°C and an inside temperature of 20°C, the heat loos through the cooker hood is 1.5kW and on a similar scale than the energy consumption of a water kettle.

To evaluate the energy loss of 1.5kW into a financially, we must take the energy cost of the heating system into account. This can vary individually and leads to interacting effects of different energy measures. A good first order estimate is to consider your gas price and assume a boiler efficiency of 100%. For a gas price of 0.15€/kWh, the heat loss caused by the cooker hood is 0.225€/h. With an assumed electrical power of 0.5kW for the cooker hood, the cost for electricity are of similar size (0.5kW * 0.45€/kWh = 0.225€/h) and the total operation cost are in the order of 0.5€/h.

The use of the cooker hood to prevent moisture and odors in the home is still very important. However, using a lid on the pot and operating the cooker hood at reduced power can have a positive effect on your energy bill.

**Prof. Dr. Dr. Wilko Rohlfs** |
Department of Thermal Fluid Engineering (TFE)
University of Twente | w.rohlfs@utwente.nl