Energy consumption in properties

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Availability of energy

Energy and the environment are areas that are in focus both globally and nationally, not least since Al Gore travelled around the world during 2006-2007 and described the environmental consequences of global warming and carbon dioxide emissions from fossil fuels.

We are affected by our environment. Oil price developments are affecting the price of other forms of energy such as electricity and heating. Today, we see oil as a source of energy which will come to an end, bringing with it major negative environmental impact and the associated environmental taxes levied by the state. Oil-heating in Akelius properties will be phased out rapidly.

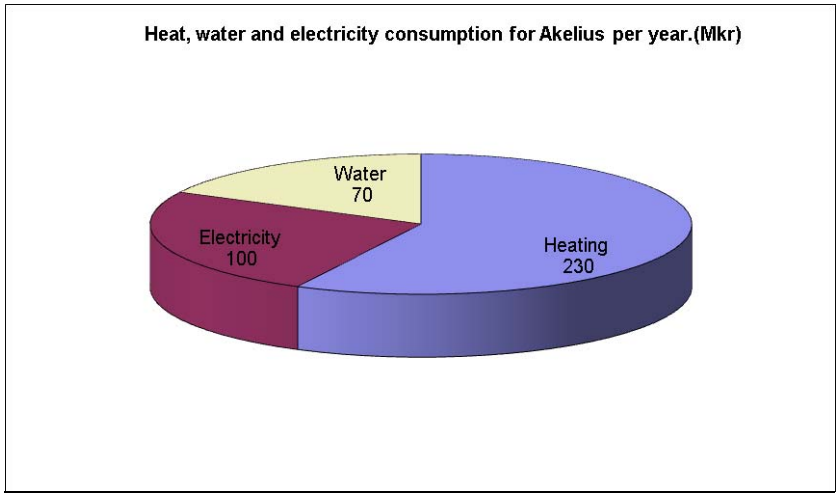
District heating is the option that has grown fastest in Sweden, and currently accounts for 50% of all energy used for heating. District heating is currently used in 270 of Sweden's 290 municipalities.
From an environmental aspect there are positive effects, almost all the new heating production is based on bio-fuels which are carbon dioxide-neutral. The disadvantage from a customer perspective is that, it is a monopolistic market and the cost increase has been high for several years.

In Sweden the electricity market was deregulated in 1996. Originally, there were many small private operators and also some larger one; today however, there are basically three major operators in Sweden. This together with state energy taxes and VAT has contributed to the fact that the price of electricity has more than doubled. Today electricity is sold at market prices.

Several European countries are developing and expanding their nuclear power plants; Sweden is an exception which stands by the referendum decision of 1980, namely that nuclear power should be phased out before 2010. The end time for complete phasing out is no longer in force, but there is no definitive new date which has been adopted. The reactors in Barsebäck were decommissioned 1999 and 2005.

In recent years, several wind power plants have been built in Europe.
However, the amount of electricity that is produced in wind power plants is not sufficient enough to replace nuclear power, which along with waterpower is the largest producer of electricity

As an individual real estate owner it is of course impossible, to a greater extent, to affect the production of energy, whether for heating or electricity. However, what we can do is to look at our own buildings. We can avoid consuming more energy than necessary and we can look ahead at our choices of technical solutions in existing, and new buildings.
The cost of electricity, water, and heating is the single largest cost for Akelius. In *Picture 1*, the costs are broken down by types of cost.



Picture 1. Heat, water and electricity consumption for Akelius per year. (Mkr)

Different types of buildings

Briefly described below are the various technical functions of two different types of buildings;

• Residential buildings
• Public Buildings

Residential buildings

Accommodation with bedrooms, living room, bathroom, and kitchen.

Energy consumed can be divided into four parts:

- Heat
  Heat up the apartment to a minimum of 21ºC, regardless of the outdoor temperature. The function will maintain an even room temperature.
- Hot water
  Cold water is heated to 55ºC and tapped in bathroom and kitchen.
- Ventilation
  Fresh air is added by a vent in the windows, heated by the radiators when needed, and extracted through exhaust air devices in bathroom and kitchen.
- Electricity
  Lighting, electricity to ovens, refrigerators, washing machines etc.

  Stairwells, laundry rooms, basements, storage and garages are examples of spaces that also need heating and electricity.
  Regulating valves are installed in the heating system, to ensure that the heat flow is properly distributed throughout the building.

Public buildings

For Akelius, one good example of public buildings is property for elderly people.
The tenant has their own apartment with bedroom/living room, small kitchen, and bathroom. Furthermore, there are large common areas such as living rooms, central kitchen, large laundry room, staff rooms, and offices.

Energy consumed can be divided into five parts;

- Heat
  Heat up the apartments to 22-24ºC, regardless of the outdoor temperature. The staff rooms, central kitchen and offices are heated to 20ºC.
- Hot water
  Cold water is heated to 55ºC and tapped in bathroom and kitchen, preferably in the central kitchen.
- Ventilation
  Balanced ventilation. The airflow varies in the different areas, depending on what kind of activities that take place there.
- Electricity
  Lighting, electricity to ovens, refrigerators, washing machines etc.
- Cooling
  The office areas have a system with a cooling plant/air conditioning, to avoid excessively high room temperatures during summertime.

Heat – Ventilation – Cooling - Regulation

The basic parts that have been described above will now be explained in their structure and function:

Heat production
In Sweden, the most common way of producing heat is through district heating. The heat is produced in a district heating plant located in or nearby the town where the building is located. Heating water at 70-110ºC is distributed in pipes into the heat exchanger room in the actual building. Besides the heat exchangers, there are also circulation pumps, regulating valves, regulating system and the energy meter found in this room. In the heat exchanger room, the heating system is divided into two systems;

- Heat
- Hot Water

Heat

The most common way of warming up buildings is the use of radiators placed below the windows. Each radiator is individually regulated via a thermostat.
The heating water is distributed by a piping system, and circulated by a circulation pump. The temperature of the heating water is regulated by the outdoor temperature.
If the building has balanced ventilation, a system with heating water is required to warm up the cold air, before it is blown into the areas.

Hot water

Cold water at 6-10ºC is heated up to 55-60ºC, the water is distributed in pipes under the pressure from the water supply plant. There is also a small circulation pump to ensure that the temperature of the hot water is maintained.

Cooling

Cold is produced by a cooling plant/air conditioner, compressor, often located on the roof or in the fan room. The chilled water is distributed in pipes to either the air coolers in the ventilation system, or to climate units. The temperature of the cooling water is controlled by valves and regulated by the temperature in the actual room.

Ventilation

Basically there are four types of ventilation systems;

- Natural ventilation
- Mechanical ventilation
- Balanced ventilation
- Balanced ventilation with heat exchanger

Natural ventilation

This kind of ventilation is common in old buildings; the air is extracted from the rooms through air vents, and via ventilation ducts in the chimney. This principle is based on a hot chimney which creates an air agitation. Today, when buildings are heated with district heating the chimneys are no longer hot, so the result is poor.

Mechanical ventilation

Fresh air is added by a vent in the windows, heated by the radiators when needed, and extracted through exhaust air devices in the bathroom and kitchen. On the roof, or in the attic there is a mechanical fan to ensure the right amount of air is extracted. Every air extraction device is adjusted to a specific air flow, depending on the size of the room/apartment.

Balanced ventilation

The air extraction system is basically the same as for mechanical ventilation. There is an air extraction fan on the roof, and the air is extracted through exhaust air devices.
The difference is that there is a mechanical air supply fan which blows fresh air in, via ventilation ducts, through air vents into the rooms.
The same amount of air that is blown into the building is also extracted, and there is the balance.

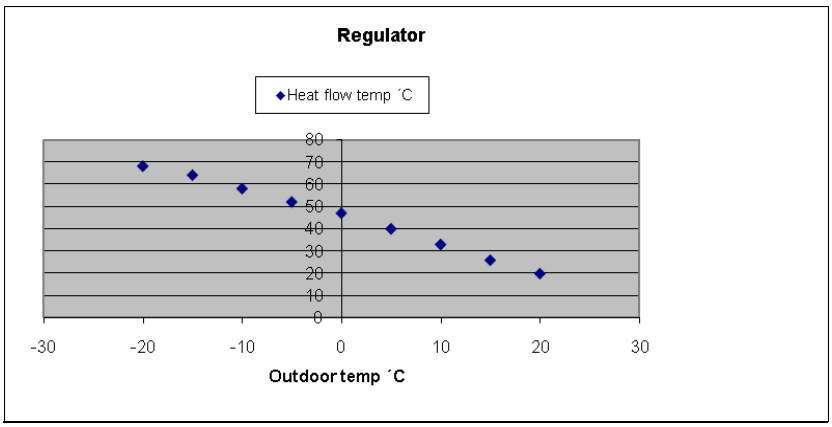
Balanced ventilation with heat recovery

To recover energy from the exhaust air, there must be a heat exchanger. This is possible if the exhaust air fan and the supply air fan can be placed together. There are basically two types of air heat exchangers; rotating and cross flow.
When using a rotating heat exchanger, the recovery ratio can be as high as 80%.

Regulation and monitoring of temperatures and systems

Regulation

Easily described, regulation consists of the following: one signal in – a regulator – and one signal out. In this case, the signal comes from an outdoor temperature sensor. The regulator sends the signal to an actuator that opens a heating valve. Depending on the outdoor temperature, the correct amount of heat is delivered to the heating system. To know the temperature of the heat flow the regulator uses a regulating curve, see *Picture 2* below. Each regulating curve is unique for each system, building and geographic area. In this example the heat flow temperature is 60ºC at an outdoor temperature of -10ºC.



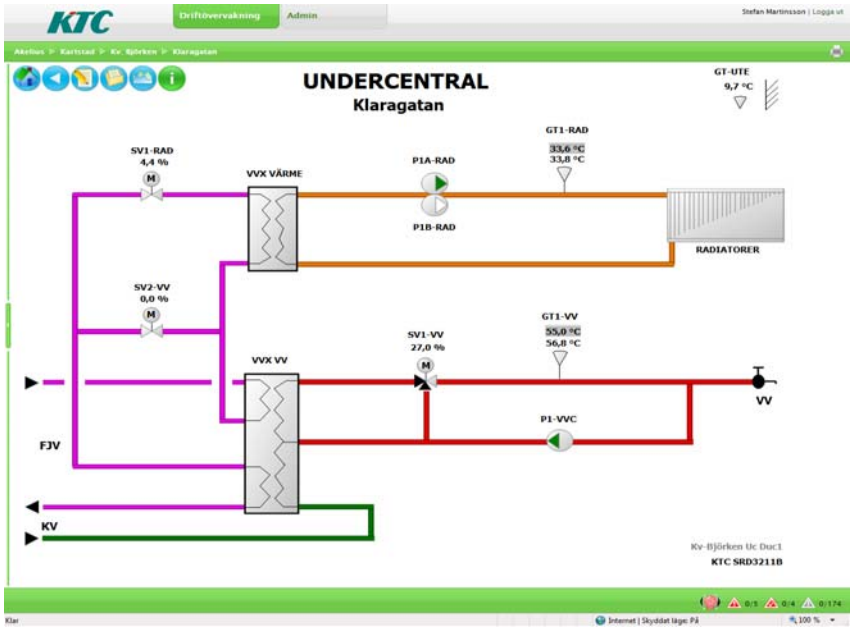
Picture 2. Regulating curve

This kind of regulation is used for radiator systems, heating for ventilation systems, and sometimes even for cooling systems.

To regulate hot water where the temperature shall remain constant, a regulating curve is not necessary. If the temperature drops below 55ºC, the heating valve opens and adds more heat.

Monitoring

With today's technology, a computer is often used to monitor the regulation of heating, hot water, and ventilation.

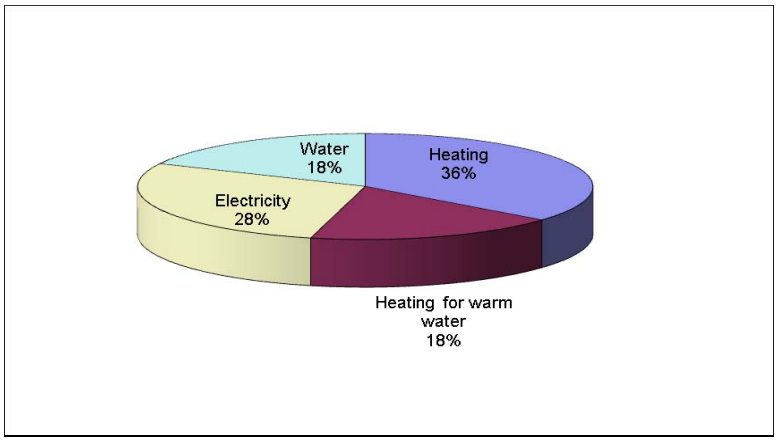


Picture 3. Monitoring heating and hot water

Picture 3 shows how monitoring of heating and hot water can be done with the aid of a computer. It shows the pumps, valves, and sensors with their different temperatures. Via the internet the temperatures can be modified and optimized with a simple click on the keyboard. If temperatures drop below a set point, an alarm goes off and is sent to service personnel by SMS and E-mail.

The consumption of energy in properties

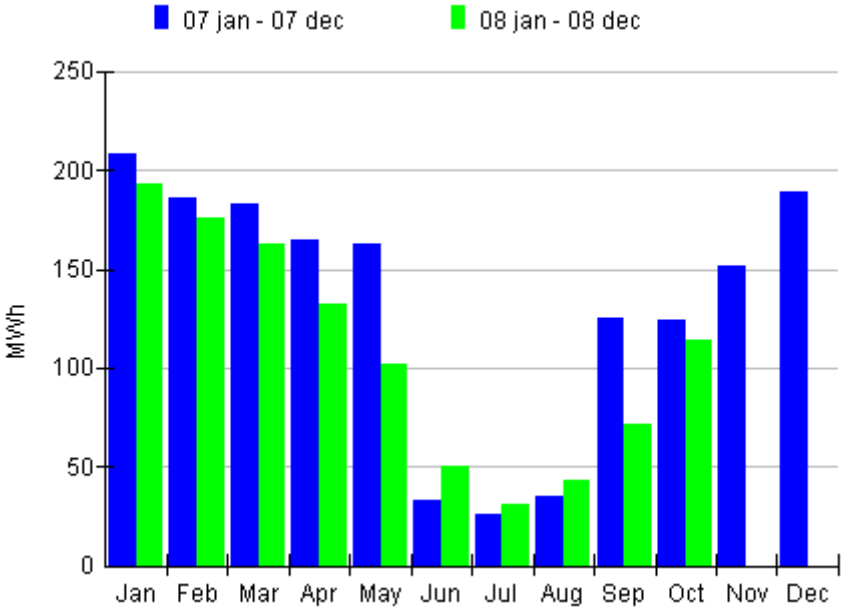
Heating is the largest single energy cost in residential properties equaling 54% of the total cost, but it is only 36% that is used for warming up the building. The other 18% is used for producing hot water. Cold water in itself consumes no energy, but accounts for 18% of the total cost; therefore it is just as important to reduce cold water consumption as to reduce energy consumption.



Picture 4. Consumption of electricity, cold water, heating, and hot water for heating.

To compile how much electricity, heating, and cold water costs is one thing, but to compile the consumption in kWh and in cubic meters is a totally different matter. The consumption is received from meter readings, manually or automatically.

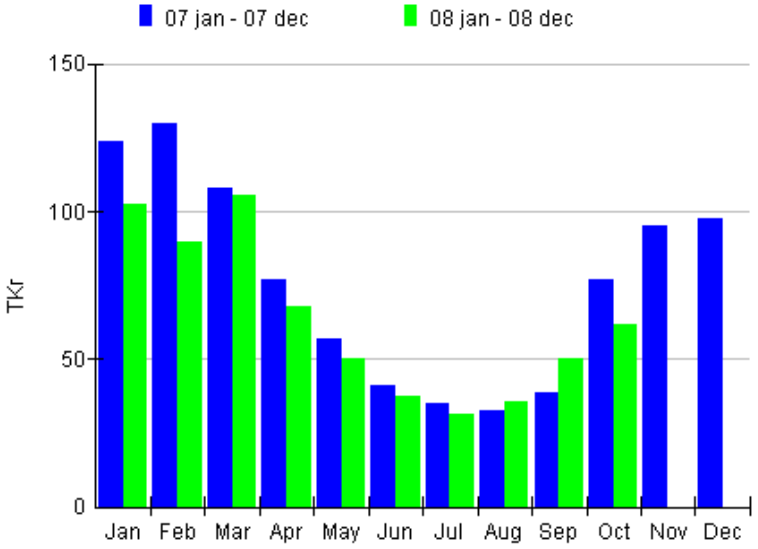
For several years Akelius has done meter readings, monthly, for electricity, heating and water. The result is put into a program called WebEss. *Picture 5 is an* example of what the reports from WebEss look like.



Picture 5. Consumption of heat, period January 2008 – October 2008

In the bar chart in *Picture 5*, the consumption of heat is shown. The green bars represent the consumption for 2008, and can be compared with the consumption for 2007, the blue bars. It is worth noting that the consumption in this report has been corrected with a climate factor; this makes it possible to compare the same month, different years, regardless of the outdoor temperature.

The reports for water and electricity look the same as for heating, with bars showing the consumption per month, compared with the month for the previous year. These reports are important instruments for being able to continuously follow up the consumption. *Picture 6* shows the cost for the consumption.



Picture 6. Cost for heating, period January 2008 – October 2008

Measures to reduce the cost of energy

There are many ways of reducing the cost of energy in properties, such as insulation of attics, insulation of walls and installing new energy efficient windows. There are also ways of reducing the cost of energy in the technical systems. Here are some examples:

Operating time for air handling units

This applies mainly to offices, but it is a very good way of saving energy. Ensure that the fans start and stop depending on whether there are activities on the premises or not.

Fans in residential buildings must be in operation 24 hours a day.

Direct driven exhaust fans

Old exhaust fans from the 60´s, 70´s and 80´s are belt driven which means that the fan motor and the fan are separated from each other. One option is to replace the existing fan with a new direct driven exhaust fan; the efficiency of a direct driven fan is twice as good, compared with the old type fans.

Example:

Belt driven fan	Direct driven fan
Oper. time 8,760 h/year	Oper. time 8,760 h/year
Effect 1 kW	Effect 0.5 kW
Cost per kWh 1.39 kr	Cost per kWh 1.39 kr
Life 15 years	Life 15 years

At today´s price of electricity, the old fan would have cost 182,000 kr during its lifetime and the new direct driven fan only 91,000 kr. A residential building with 30-40 apartments has two or three fans of this size.

Specific Fan Power - SFP

When installing a new air handling unit the term SFP, or Specific Fan Power, is important to consider. The SFP-factor describes the amount of electrical power in kW, required to blow one cubic meter of air per second. The SFP-factor should be 1.5 or less in new ventilation systems and 2.0 or less when modifying existing systems. The SFP-factor is an accurate measurement of the electrical efficiency of the air-handling unit, and can easily be obtained from the manufacturer. In public buildings where the ventilation system is operated 24 hours a day, the SFP-factor becomes an even more important issue.

Example: Air handling unit, capacity 1 m3/s, SFP 2 instead of SFP 3, operating time 24 hours per day.
Today's cost of electricity, 1.39 kr/kWh.
Life: 20 years.

SFP 3 x 8 760 h x 20 years x 1.39 kr/kWh = 731,000 kr
SFP 2 x 8 760 h x 20 years x 1.39 kr/kWh = 487,000 kr

Water

When the consumption of water is reduced, the cost for heating warm water is also reduced. With very simple measures the consumption can be reduced by10%, sometimes by as much as 20-25%. The actions to be taken are, replace existing shower handles with new efficient ones, replace existing aerators in bathroom and kitchen mixers, also reduce the amount of water when flushing the toilet. In today's terms, the cost of these measures is about 700 SEK per apartment, and the pay-off time is sometimes less than two years.

Individual metering

Residents often find it too complicated to become engaged in household energy conservation, it does not have to be so. Individual metering and billing of electricity, as well as hot and cold-water billing, raises a resident's awareness and motivation to reduce energy consumption. It is not unusual to see hot water consumption reduced by 20-30 % when so-called "dry rent" is in effect. Both radio-based (wireless) systems and cabled systems for data collection of water, electricity, temperature etc are readily available on the market.

Replacing analogue control systems with computerized control systems

Old analogue control systems have a simple regulation with a few fixed set points and a linear displacement of the heating system temperature. Often the need for heating at 0ºC outdoor temperature sets the heating system temperature for higher and lower outdoor temperatures which means that too much heat is consumed. No temperatures can be read, and there are no alarms.

Efficient computer technology provides other opportunities; any changes, such as lower control curve, *(picture 2)*, are recorded and stored in a data base. To be able to optimize a heating system, the system temperature must be adjusted downward in many small steps; this is not possible with an analogue system. With a computer, the control curve can be adapted more precisely for the fluctuating outdoor temperature with up to nine set points instead of two. The circulating pump will stop when there is no need for heating.

When installing a computerized control system, the savings are 5–15% of the heating consumption. For a residential building with 50 apartments, the pay-off time can be somewhere between two and four years.

Summary

The measures mentioned above are, of course, only some examples of how to reduce energy consumption in properties. What we do know is that in the long run, the cost of energy will increase; we also know that it is time-consuming work to reduce the costs. Therefore, it is important to define the need for measures in respect of each individual property, and take necessary action as soon as possible.