

The Cloak of DEMAND

how to reduce the energy used for heating by around 56%



The inspiration for the Cloak of DEMAND comes from an entry in Kris de Decker's blog: <http://www.lowtechmagazine.com/2015/02/heating-people-not-spaces.html> (comment 16)

'My wife and I began experimenting with clothes for heating about five or six winters ago. The initial goal was to see if we could find clothing which would keep us warm, comfortable and happy [in a 15th Century house in Burgundy] even without any kind of additional heating source. We started the experiment in the first winter with modern clothing solutions: high tech thermal layers, specialist outdoor gear and the like, but found that the problem with most of them was the extremely large surface area associated with modern fashions. The style of modern clothing more or less mirrors the surface area of the skin - the surface area of trousers mirror the surface area of the skin on legs and so on. Some of these technical fabrics worked well for relatively short periods of time, but most simply failed to keep in enough heat when days and weeks went by with temperatures close to or below freezing. To retain anywhere near enough heat, we had to resort to wearing clothing designed for outdoor extremes. It was uncomfortable to wear indoors, made us feel stupid and miserable and so we abandoned the experiment in the first winter and switched the heating back on.

The exterior and lower layers of the house are medieval but the interior was remodeled in the 18th century, so the next winter, we experimented with 18th century fabrics and fashions. After all, there was no central heating in the 18th century, so clothes must have been warmer right? Wrong. We found

18th century inspired clothing to be just as ineffective against the cold as their modern equivalents and came to the conclusion that the well known fashions of that era were by and large a mere statement of personal wealth: i.e. the frock coat, waistcoat and breeches were an outward reminder to people that the wearer could afford to buy over 200 cubic meters of wood a year to heat a house like ours, as well as the servants to keep the fires stoked.

The next winter, we went further back to a time contemporaneous with the building of our house: the late medieval period. After three freezing cold winters' worth of experimentation and with the discovery of just two principle items of clothing, finally we hit the 'heat your body not the air around you' jackpot. The first of the two items was an ankle length, long sleeved medieval-styled house coat and the second was a four cornered 'Erasmus' styled soft hat.

The design of each of these two items proved to be so efficient at heat conservation and so incredibly versatile, that we now wouldn't wish to face a winter without them.

The Coat

After a few attempts with wool, we turned to a double thickness recycled fleece, with a plain exterior and a mock sheepskin interior. It is a wonder fabric: light, easy to wash and relatively quick and easy to dry. The cut of the coat is 'A' shaped, being narrow at the top of the shoulders and very full at the ankles (at least as wide as the wearer is tall and then some). The sleeves are worn long and relatively narrow at the wrist. We added hoods to the coats instead of collars and snap fasteners every few centimeters to the full length of the front. The hoods come in handy on really cold nights for the same reasons as the hooded chair: they block out the cold from behind and capture any heat escaping from the neck of the coat. In effect, the coats have the appearance of a cross between a monk's habit (when fully closed) and a medieval knights' watch coat (when opened or buttoned only at the neck).

The 'A' shape, effectively channels all your body heat upwards and back toward your body. This effect is something you have to experience in order to fully appreciate. Body temperature can be very precisely regulated by opening and closing fastenings up to the waist, up to the neck or leaving the coat completely open (a loose clasp is very useful across the neck for temperatures more suited to a cloak rather than a coat). The full shape is also very comfortable to walk around the house in; as comfortable as pyjamas and not at all like wearing a coat indoors, even over other clothes.

The fullness of the coat means that it is also big enough to use as a sofa 'throw' when spread out. To sum up, I have worked all day, day after day, very comfortably in an unheated studio, where the ambient temperature was well below zero degrees Celsius wearing the following items:

1. Erasmus hat (fleece, flaps down)
2. Long coat (fleece, mock sheepskin inner)
3. Neck loop (warming the air that you breathe - silk)
4. Commercial thermal base layer.
5. Pajama shirt (flannel)
6. Sleeveless jerkin (knee-length, round-necked garment, straight-cut or 'A' line, any warm material (recycled fleece is the easiest and lightest)).
7. Warm trousers.
8. Warm socks
9. Leather shoes.

Although I've experimented very successfully with a full medieval 'kit', for the sake of not appearing to be insanely eccentric when anyone rings the doorbell, I find that the coat and hat work well with well layered modern clothing and using snap fasteners on the coat means that they can be removed quickly if needed!

The Cloak of DEMAND

The DEMAND version (a hooded cloak) is made of three elements: a) a large blue dressing gown, cut up the sides under the arms to let in the yellow triangular panels. b) some large triangles of yellow furry fabric inserted into the blue dressing gown – and rectangles of yellow, to make the gown reach the ground, as described above. c) a second short red dressing gown with a hood, which makes a lining and hood for the cloak as a whole. It is fastened with a bit of elastic around a large plastic button (in fact a VW badge with holes drilled in it.). The total cost of the outfit (parts sourced from charity shops) was about £15. Wearing this, and some clothes underneath, it is fine to be sat working at a desk at 14 degrees C.

So let us imagine that Marks and Spencers/other clothing manufacturers developed this prototype, and that Cloaks of DEMAND were entirely normal wear in the UK indoors, in winter.

Heating the person and keeping the heat from the person is more effective than space heating, so how much energy and CO2 might this 'technology' save?

This was the response I got from BRE (thanks BRE!)

Here are the numbers from BREDEM for a typical semi-detached house (with gas heating) starting with the thermostat set to achieve a living room temperature of 21°C and then reduced in increments of 1°C. It is assumed that the rest of the house is about 3°C cooler than the living room. Savings for initial 1°C reductions are >10%, but then fall as the house gets cooler. Also important to note that this is just space heating energy (not total energy). As a percentage of total household energy consumption the fall would be lower.

Reduction in thermostat set point (°C)	Reduction in space heating energy requirement	Marginal saving for 1°C reduction
1	13%	13%
2	25%	12%
3	36%	11%
4	46%	10%
5	56%	11%
6	65%	9%
7	72%	7%
8	79%	8%
9	87%	7%
10	92%	5%

There will be some months with zero* heat demand when you set a low thermostat temperature. The implication is that it will tend to zero in all months if the set point is low enough. However, predicting the temperature at which this will happen is tricky in any model because in practice it is very dependant on gains and their distribution between rooms.

* The heat load actually ‘tends to zero’ rather than ever reaching zero since there is assumed to be a normal distribution of temperatures around the monthly mean. So you tend to get a very small heat requirement even where the monthly mean temperature is above the set-point. (Except in the summer months where we deliberately force it to zero.)

Notes:

1. Figures quoted as a reduction in space heating energy only (not total energy).
 2. It assumes all rooms are heated to (and achieve) the demand temperature (whereas in practice EFUS showed us that 50% of homes have 1 or more rooms that are partially heated or unheated) and some heating systems/emitters may be undersized and actually not capable to heating as well as the higher temperatures assumed. Therefore, it is likely to slightly over-estimate savings compared to real homes.
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The Cloak in action

It looks like the Cloak of DEMAND would enable people to enjoy lets say a 5 degree drop in indoor temperature and 56% of the energy ‘requirement’ for heating.

Some people might have objections to this idea. Reducing temperatures raises alarm bells for those concerned about fuel poverty. However, people who wear the Cloak of DEMAND are **not cold**. In fact, the Cloak is a really excellent solution for those who can’t afford a lot of space heating.

Some people might think the Cloak looks ridiculous. But remember, clothing styles come in and out of fashion all the time. There is nothing ‘natural’ or inevitable about current trends. It is a bit tricky going up and down stairs, but the Cloak we have made is just a prototype – there is room for development.

Questions arising from the Cloak

For energy policy makers: what assumptions are you making about ‘normal’ clothing? Where do these assumptions come from? Can they be challenged?

For clothing manufacturers: Why cut the dressing gown short, why make it of only one layer, and why not include a hood as standard? Why not mass produce Cloaks of DEMAND (we know many people who are envious).

For energy researchers, engineers and scientists: What can be done to make better use of the body’s own thermoregulatory system (and clothing) in conceptualising and designing the future of heating?