Reducing CO2 Emissions by Heating and Cooling People Rather than Buildings

By Geoff Graham

July 24, 2022

Questions? Comments? Anything left out? Anything you disagree with? I'd love to hear your thoughts. Email me at gjgraham4health@protonmail.com.

Follow me (forever free) on Substack at https://geoffreyjgraham.substack.com/

Summary

The heating and cooling of buildings emits enormous amounts of carbon dioxide into the air. In cases where buildings have few occupants, it might be better to heat or cool individual people using artificially heated or cooled clothing. Both types of clothing are sold in the United States. Heated clothing includes gloves, socks, footwear, pants, jackets and other items, all of which are warmed by battery power. Cooled clothing consists mainly of vests and undervests, cooled by several different methods. Although both heated and cooled clothing are expensive, heated clothing is less expensive, as well as being more practical and probably more comfortable. If we could lower the price of heated and cooled clothing, and increase its comfort, we might prevent significant carbon dioxide emission. Investors should regard temperature-controlled clothing as an active, but not yet mature, market.

.

The CO2 cost of heating and cooling buildings. According to the United States Department of Energy, air conditioners use about 6% of all the electricity produced in the United States, at an annual cost of about $29 billion to homeowners. As a result, roughly 117 million metric tons of carbon dioxide are released into the air each year.

According to Jessica Leung of the Center for Climate and Energy Solutions, in 2015, about 1000 million metric tons of CO2 were released into the atmosphere from residential buildings (see Figure 2 of the Leung presentation), of which 38% could be attributed to space heating or cooling (see Figure 1 of the Leung presentation). In that same year, about 900 million metric tons of CO2 were released into the atmosphere from commercial buildings (see Figure 2 of the Leung presentation), of which 30% could be attributed to space heating, cooling, or ventilation (see Figure 1 of the Leung presentation).

When CO2 emissions generated on-site and indirect CO2 emissions from the use of electricity generated off-site are added together, residential and commercial buildings produced 1.9 billion metric ton equivalents of CO2 (In the Leung presentation, see text beginning near: fuel combustion in the). New buildings use energy more efficiently than old ones do. However, in 2012–2013, the median ages of a U.S. home and commercial building were 37 years and 32 years, respectively. Slow turnover means that by mid-century much of the existing U.S. building stock will be 70 years old. (In Leung presentation see text beginning near: the median ages of)

Heating or cooling individual people. Although it is expensive in energy and CO2 emissions to heat or cool entire buildings, it might be less expensive to heat or cool individual people within those buildings. An example of this that is familiar to many people is that of electric blankets, which can keep a sleeper warm within a frigid house—at least until the sleeper has to get up in the middle of the night.

Artificially heated and artificially cooled clothing are both marketed in the USA. There are more brands of artificially heated clothing than artificially cooled clothing for sale. The heated items of clothing are less expensive than the cooled items and are probably more comfortable—although I have not examined any item of either type.

Battery-generated heat: basic information. According to the website of one vendor of battery-heated clothing (voltheat.com), rechargeable batteries of 12 volts, 7 volts, 3 volts, or 1.5 volts (AA batteries) supply the current that heats the clothing. Usually, the higher the voltage, the greater are the heat output and the body area that can be covered. However, the higher the voltage, the more expensive and heavier are the batteries. Most batteries in heatable clothing produce current of 7 volts. Clothing heated with 7-volt batteries usually includes 3 or 4 heated zones or pads, while clothing heated with 5-volt batteries usually included 2 heated pads. 3-volt batteries are usually used to heat smaller areas such as footwear.

Battery capacities and prices. In a haphazard survey of the Internet, I found advertisements for several batteries. My inclusion of them here is not a judgment on their value:

ICONX sells 7.4-volt lithium-ion replacement batteries for heated clothing (heated vests and heated pants). These batteries produce about 6.5 hours of heating current at the ***Low*** setting, 3 hours at the ***Medium*** setting, and 2 hours on the ***High*** setting. Buyers are warned that the performance of individual batteries may vary and that the batteries and the battery charger are guaranteed for only 90 days. The battery charger is sold separately from the batteries. Each battery costs about $35.00.

Lenz sells lithium-ion batteries for heated socks. There are two batteries in a set. The batteries can provide current at three different levels. At the ***Low*** setting, a battery will provide current for 14 hours. The batteries are said to operate well in the extreme cold. The heat level can be adjusted with a Smartphone, which will also inform the user of the battery level. However, a person without a smartphone can regulate the heat level. One reviewer uses the warm socks for skiing. The set of two batteries sells for $234.95.

Hotronic sell a number of different batteries for heated clothing including both lithium-ion batteries and nickel-metal hydride (NiMH) batteries. One example is meant to power heated socks. These have three standard settings plus a boost setting that reverts to "High" after 3 minutes. The purpose is to heat socks. This company also has batteries for warmed gloves and mittens. There is a limited warranty that lasts for 2 years. The price is $70.

Gerbing sells a 7-volt rechargeable battery that can power all generations of Gerbing heated gloves, vests, jackets, and socks. The battery will deliver the following outputs:

High 100%: 135 F, 2 Hours;

Mid/High 75%: 115 F, 3 Hours;

Mid/Low 50%: 105 F, 5 Hours;

Low 25%: 85 F, 8 Hours

The battery capacity is 2.6 Ah. It weighs 4 oz.

The power can be monitored and changed from 25% to 100%. It is possible to check the remaining power. There is a limited lifetime warranty. The price is $39.99.

Volt sells a 3-volt 5-amp-hour intended to heat clothing. The battery costs $39.99.

Examples of heated clothing. Most standard articles of clothing have electrically heated counterparts. My haphazard search of the Internet (mentioned above) located a vendor called "Weston" that sells a heated long-sleeved shirt for $59.95. This shirt has three temperature settings, including the maximum of 150 °F.

The Warming Store (thewarmingstore.com) sells battery-heated gloves, socks and footwear, pants and pant liners, heated chairs and seating, insoles, scarves, heated headwear and an assortment of batteries and battery chargers. Similarly, Fieldsheer sells heated gloves, heated insoles, heated jackets, heated socks, heated rain pants, heated regular pants, heated sweatshirts with hood ("hoodies"), heated vests as well as batteries and battery chargers. Gobi Heat sells both heated chairs and heated clothing.

Cooled clothing. As mentioned above, cooled clothing seems to be more expensive on average than is heated clothing. A number of items of cooled clothing are sold at The Warming Store website (thewarmingstore.com), mycoolingstore.com, amazon.com, arcticcool.com, octocool.com and other websites.

The Staycool under-vest costs $190. Cooling is provided by 4 replaceable Thermo-Paks. Each Thermo-Pak set is good for 3 hours of cooling. The under-vest weight, with hydrated Thermo-Paks is 5.5 pounds. Each vest comes with 2 sets of Thermo-Paks, so that one can be cooling while the other is in use.

Polarforce overalls cost $203.52. The CoolShirt Active Aqua Vest costs $314.99. The First Line Technology PhaseCore XPC Cooling Vest costs $429.95. The Coolshirt Cool Vest costs $964.00.

A few items of cooled clothing cost less than $200. The New Balance Cooled Shirt costs $139.00 and a Mobile Hydrologic Cooling Vest costs only $44.99.

Cooled clothing achieves its cooling effect via a number of different principles. Vests, for example, include phase change vests, evaporative vests, circulatory cooling vests, and vests that stay cool through chemically enhanced evaporation (Hyperkewl vests) (see thewarmingstore.com website).

As discussed in a short Wikipedia article on air-conditioned clothing, it is easy to manufacture artificially cooled clothing, but very difficult to ensure that such clothing is comfortable to wear. The easiest method of cooling clothing, which uses cold liquids or cold solids, feels cold and wet against the wearer's skin. For example, the New Balance Cooled Shirt, mentioned above, is cooled by water running through plastic tubing in the fabric of the shirt.

It would not be surprising if comfortable cooled clothing turned out to require at least four components: a humidity absorber such as silica gel, a cold material to

cool the air, battery powered fans to move cool air over the wearer's body, and comfortable fabric. Adding to the difficulty of manufacture, such clothing would have to be washed or otherwise cleaned occasionally.

Suggested design improvement. One feature that might improve both heated and cooled clothing would be the ability to increase or decrease the temperature of specific areas of the clothing. The wearer might do this by swiping up or down on the area using an index finger. Naturally, this feature would be difficult and costly to implement.

Concluding remarks. Many heated buildings, including most residences, have only a few occupants most of the time. If the policy in all such buildings were to heat or cool each occupant, rather than the entire interior of the building, it might save large amounts of energy and prevent emission of large amounts of CO2.

Unfortunately, heated clothing and—especially—cooled clothing is likely to be less comfortable and less convenient than a temperature-controlled building interior. It behooves us to intervene as a society to ensure that heated or cooled clothing is as comfortable, convenient, and affordable as possible. This will require that the federal government fund the research, development and marketing of controlled-temperature clothing and that we encourage and reward businesses that develop and market useful examples of such clothing.