Storing energy

Energy from solar collectors that heat air has commonly been stored in insulated bins of rocks. Fluid-based solar heating systems commonly rely on tanks of water.

There is also a category of thermal storage that involves the use of a "eutectic"; a eutectic refers to things that can be melted and frozen. The advantageous property of a eutectic is that it stores and yields a lot of energy when changing from one phase to another. The most commonly used material in this category is water. Ice keeps your drink at a constant low temperature until the last of it has melted (or frozen).

During a period of inadequate employment I worked as a security guard (I'll never get around to writing my book titled "The Adventures of Rent-a-Pig"), My beat sometimes involved sitting still in a pickup truck for hours at a time in Colorado winter nights. Paraffin melts at about 140 degrees F, and remains at about that temperature until it re-freezes. I filled a gallon can with paraffin, melted it by putting the can in boiling water (houses have burned down because people were melting containers of paraffin directly over the fire), wrapped it in an old blanket, and used it as a foot-warmer during my watches. One tricky thing about paraffin however it that it expands and contracts a lot as it melts and freezes. So the cap should not be on the can while heating, and needs to be loosened periodically while cooling.

There are also chemical reactions that can store heat. Calcium chloride for instance has a powerful attraction for water molecules. When it is heated enough to drive out all the water and then allowed to cool, it will produce significant heat when re-exposed to moisture. I know of at least one commercial thermal storage system based upon this principle. There are commercially available hand-warmers that are activated by allowing two chemicals to mix.

Batteries have been here longer than any of us, but there is a price to pay. A lead-acid battery that is about 70% charged may store over 80% of the charging current. By the time it's 90% charged however, the charging efficiency will drop off to about 60%. Varying efficiency losses are unavoidable with any battery technology. Another problem with batteries is that they typically last only a few years. Replacing a massive bank of batteries is an ecological and financial disaster.

Compressed air stores energy proportional to the square of the pressure. Years – decades – ago I read of a go-cart powered by a modified air-hammer. The claim was that with a tank of nitrogen pressurized to the obscene extreme of twenty thousand PSI (I have never heard of such pressures, and frankly remain skeptical), it had a theoretical range of 600 miles.

The problem with compressing air or any other gas is that the temperature increases with the pressure. So right off the bat you lose energy in the form of heat when you allow it to return to ambient temperature. The interesting side of this is that as you allow the pressure to escape while yielding mechanical energy, it also cools. Those of us who have used jackhammers or other air-powered equipment are familiar with the frost build-up that can occur; if you happen to want a refrigerator however, you're in luck.

While speaking of compressed air (though not directly related to storing heat), there was an incredible fire-starting device discovered in occasional use in Southeast Asia called a fire-piston. A close tolerance stick sealed by a greased winding of thread was fitted into a precision hole about three inches deep (the stick and hole were about 3/8" diameter).

There was a shallow hole in the inside end of the stick that held tinder. When the piston was forcibly plunged down the cylinder and immediately withdrawn, the air (heated to about 800F) ignited the tinder. A traveler from Europe observed a Philipino using one to light a cigarette and traded him a Zippo lighter and some bubble-gum for it. Some believe that this was the original inspiration for the diesel engine. I have not yet successfully built one of these – a little smoke, but so far no fire.