Solar thermal technologies can be used for water heating, space heating, space cooling and process heat generation.[20] Early commercial adaptation In 1878, at the Universal Exposition in Paris, Augustin Mouchot successfully demonstrated a solar steam engine, but couldn't continue development because of cheap coal and other factors.In low geographical latitudes (below 40 degrees) from 60 to 70% of the domestic hot water use with temperatures up to 60 ?C can be provided by solar heating systems.[23] The most common types of solar water heaters are evacuated tube collectors (44%) and glazed flat plate collectors (34%) generally used for domestic hot water; and unglazed plastic collectors (21%) used mainly to heat swimming pools.[24] As of 2007, the total installed capacity of solar hot water systems was approximately 154 thermal gigawatt (GWth).[25] China is the world leader in their deployment with 70 GWth installed as of 2006 and a long-term goal of 210 GWth by 2020.[26] Israel and Cyprus are the per capita leaders in the use of solar hot water systems with over 90% of homes using them.[27] In the United States, Canada, and Australia, heating swimming pools is the dominant application of solar hot water with an installed capacity of 18 GWth as of 2005.[19] Heating, cooling and ventilation Main articles: Solar heating, Thermal mass, Solar chimney, and Solar air conditioning In the United States, heating, ventilation and air conditioning (HVAC) systems account for 30% (4.65 EJ/yr) of the energy used in commercial buildings and nearly 50% (10.1 EJ/yr) of the energy used in residential buildings.[28][29] Solar heating, cooling and ventilation technologies can be used to offset a portion of this energy.When properly incorporated, thermal mass maintains space temperatures in a comfortable range and reduces the need for auxiliary heating and cooling equipment.[30] A solar chimney (or thermal chimney, in this context) is a passive solar ventilation system composed of a vertical shaft connecting the interior and exterior of a building.When planted on the southern side of a building in the northern hemisphere or the northern side in the southern hemisphere, their leaves provide shade during the summer, while the bare limbs allow light to pass during the winter.[32] Since bare, leafless trees shade 1/3 to 1/2 of incident solar radiation, there is a balance between the benefits of summer shading and the corresponding loss of winter heating.[33] In climates with significant heating loads, deciduous trees should not be planted on the Equator-facing side of a building because they will interfere with winter solar availability.He, along with his technical advisor A.S.E. Ackermann and British physicist Sir Charles Vernon Boys,[citation needed] developed an improved system using mirrors to reflect solar energy upon collector boxes, increasing heating capacity to the extent that water could now be used instead of ether.These cookers reach temperatures of 315 ?C (599 ?F) and above but require direct light to function properly and must be repositioned to track the Sun.[38] Process heat Main articles: Solar pond, Salt evaporation pond, and Solar furnace Solar concentrating technologies such as parabolic dish, trough and Scheffler reflectors can provide process heat for commercial and industrial applications.They can be grouped into three broad categories: box cookers, panel cookers and reflector cookers.[35] The simplest solar cooker is the box cooker first built by Horace de Saussure in 1767.[36] A basic box cooker consists of an insulated container with a transparent lid.Modern uses include concentrating brine solutions used in leach mining and removing dissolved solids from waste streams.[40] Clothes lines, clotheshorses, and clothes racks dry clothes through evaporation by wind and sunlight without consuming electricity or gas.1917 Patent drawing of Shuman's solar collector In 1897, Frank Shuman, a

U.S. inventor, engineer and solar energy pioneer, built a small demonstration solar engine that worked by reflecting solar energy onto square boxes filled with ether, which has a lower boiling point than water, and were fitted internally with black pipes which in turn powered a steam engine.Reflector cookers use various concentrating geometries (dish, trough, Fresnel mirrors) to focus light on a cooking container.