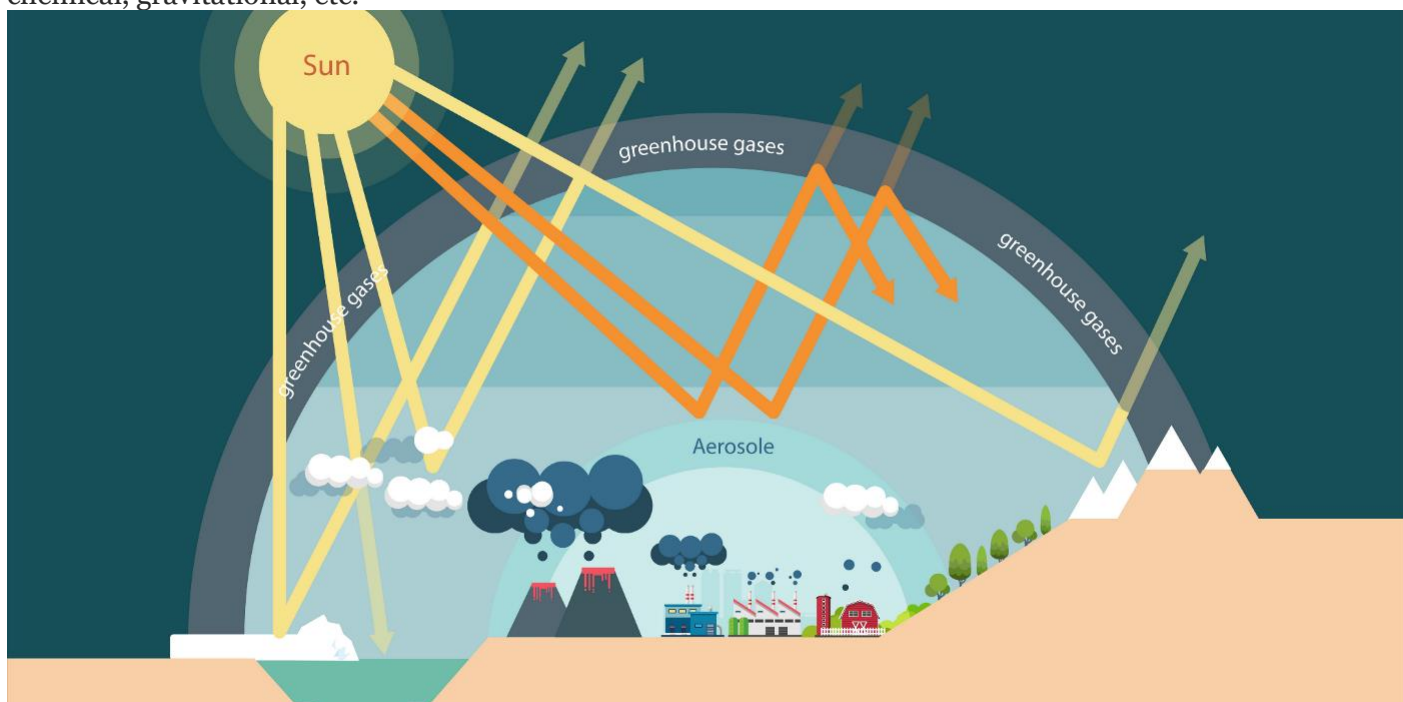


Waste Heat: An Overview

- Milind R.

This is the first article in our new series called 'The Heat Is On', which looks at waste heat and its impact on global warming.

For millions of years before human activity, the extent of heat radiated away from the earth remained largely unchanged, thus ensuring global climate patterns remained stable. Lately, the effects of anthropogenic climate change have become increasingly obvious in the form of increased incidence of forest fires, icecap melting, and hurricanes. The drastic increase in the levels of greenhouse gases (GHGs) in the atmosphere due to the Industrial Revolution has reduced the level of heat radiated away, thereby retaining more heat within the global climate system. In addition to the reduction of heat loss from the earth's surface, there is another less-discussed contribution to global warming: waste heat. Waste heat is simply all primary energy expended by human activities that is not stored as other forms of energy, such as mechanical, chemical, gravitational, etc.



Energy is expended in various activities. Some portion of the input energy is then embodied in the form of a final product. The rest of the energy (other than that utilised in the final product) is unavoidably lost in various processes in the form of heat to the surrounding environment. The extent of this waste heat depends upon the efficiencies of the various processes. For example, a chemical process converting hydrogen to ammonia locks up some energy in ammonia molecules, and the rest is required to simply heat, cool, and transport the reactants and products. In a foodgrain grinder, some energy is expended to crush the foodgrains into much smaller particles. The remaining is dissipated as heat during the process. Pumping water from ground uses energy to move water up to a higher altitude, with inefficiencies in the pump resulting in energy that subsequently heats up the pumping equipment and thereby water and the surrounding air.

Most residential energy-consuming activities are quite wasteful. All electronic items dissipate absolutely 100% of their energy consumed as waste, as does lighting and sound equipment. The vast majority of energy used for cooking manifests as heat, and only a fraction goes into changing the chemical structures in raw food. Air conditioning and fans also dissipate all their energy into the environment. Transport fares no better: only about 25% of the energy is used in moving people and goods from a lower altitude to a higher one. The remaining just heats up the ground, air, and the vehicles themselves. Transport at the same altitude or from a higher to lower altitude dissipates all energy as waste heat.

In sum, a great majority of all energy used by humans is dissipated as waste heat.

In general, about 100% of energy consumed in residential and commercial, 75% in transportation and 70% in industrial applications are discharged into the environment as heat globally (Bian [2019](#)). About 70 per cent of all the energy produced by humanity gets chucked as waste heat ([Yale environment 360](#)).

An immediate question is: what is the role of waste heat in global warming, and how does it compare to effects of the GHGs? How much does it contribute to today's measured warming of 1.1 degree Celsius compared to pre-industrial times?