

Energy Conservation and the First Law of Thermodynamics

By Jim MacInnes
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Two of the most powerful, inexpensive and easiest ways to provide for our energy needs are reducing energy consumption through conservation and energy efficiency. These efforts create what are sometimes called “negawatts” and they will allow us to extend the use of our existing fossil fuel energy supplies. They also reduce environmental costs known as “externalities,” most of which are not accounted for in the price we pay for energy.

It is easy to conserve energy simply by not using it, such as by turning off the lights when we leave a room or consolidating shopping trips. Energy efficiency on the other hand is accomplished by using a more efficient product to do the same job such as substituting Compact Fluorescent Light bulbs (CFL'S) for conventional ones, thereby saving about $\frac{3}{4}$ of the energy needed to light a room. Last year, we installed a 95% efficient boiler at our home and were able to reduce the boiler size to 105,000 Btu per hour vs. the old one, which was rated at 160,000 Btu per hour. While they both do the same job, one is just much more efficient, that is, it takes less energy to heat our house.

Energy conservation and energy efficiency measures really work and are like motherhood and apple pie. How can anyone not like them? We will all be conserving a lot more in the coming years.

While energy conservation and efficiency measures can save us a lot of energy, we still must consume ‘energy’ to do the remaining ‘work.’ In its simplest form:

$$\text{Work} = \text{Force} \times \text{Distance}$$

So, even if we can consolidate our shopping trips, we will still need to propel our 3000-pound vehicles to the store to buy food, go to work, and take vacations. And, we can't power these vehicles with negawatts. This brings us to the laws of thermodynamics.

There are many important laws of nature that govern the way our world works including the law of gravity, Newton's laws of motion and the laws of thermodynamics. *Thermodynamics* deals with the relationship between heat, work and energy.

The first law of thermodynamics is about conservation of energy. It says that while energy can be changed from one form to another, it cannot be created or destroyed. The law states that the total energy output for a system equals the energy input less the waste heat energy. What it means to us is that if we want to move people or freight from here to there, which is defined as “work,” we must

consume “energy” and we will create some waste heat in the process. Waste heat is still energy though, often just not useful energy.

While conservation and energy efficiency measures will extend the life of our fossil fuels, they won't stop their eventual depletion though, only slow down the process. We will still need huge new replacement energy sources in order to provide the motive force needed to live, do our work and power our economy.

We'll move on to the Second Law of Thermodynamics in our next report.

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