Energy, Entropy and the Second Law of Thermodynamics

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At the beginning of this energy series we made the case that real economic wealth is the ability to control the flows of useful energy and embodied energy, not money. Energy turns raw materials such as rocks, trees, water, fossil fuels, etc. into the 'stuff' of the economy such as cars, houses, bicycles and computers. It takes a lot of energy to combine all of these materials into an orderly form, like a house.

Not only must we consume energy to make things, but we must also use energy to keep them in good working order. That's where Entropy comes into play.

The second law of thermodynamics is often called Entropy, and it is an important law of nature that says everything changes over time to a higher state of **disorder**. Absent energy inputs, nature's equilibrium is disorder. The roof needs fixing, the walls need painting; the car needs new tires, etc. We all know that things must be maintained and will eventually wear out. This happens to our bodies too.

Entropy can often be reversed by investing energy back into a system, which can bring things up to their original higher level of order. In other words, we can often fix things and bring them back to their original condition provided we keep investing energy in them…up to a limit. Sorry, that only goes so far with the human body.

In business, Entropy is accounted for as "depreciation expense." Just think about how much energy is needed to maintain our homes, businesses and keep the nation's infrastructure working. We must plan on investing an annuity stream of energy over the years to keep our built environment in good condition. Not doing this is the equivalent of adding more debt.

One of our most critical infrastructure areas is the electric power system. In the next dozen years or so, Michigan electric utilities plan to retire about 3700 Megawatts (Mw) of power supply. (One Mw will light ten-thousand 100 watt light bulbs) That's the equivalent of more than 3 large nuclear plants and represents almost 15% of Michigan's installed capacity. Some of this capacity may not be needed due to slower growth, energy conservation and efficiency measures. But, much of it will have to be replaced because it still takes a lot of electricity to power Michigan's economy.

If you believe that oil and gasoline prices will continue to rise and we may eventually need to begin transitioning to electric transport, this could also increase our electricity needs. For example, what if we set a goal to eliminate 25% of the oil and gas used for Michigan passenger vehicles by switching over to electric vehicles (EV's), such as the Chevy Volt? It takes one Megawatt-**hour** (Mwh) of electricity to propel a Chevy Volt 3000 miles. In order to make this 25% transition using EV's, it would take the energy equivalent of about 4 (1000 Mw) nuclear power plants…. or 4800 (2.3 Mw) wind turbines, plus about 7% to account for power delivery losses.

In our next report, we'll look at some national energy policy recommendations prepared by the IEEE-USA Energy Policy Committee. The Institute of Electrical and Electronic Engineers (IEEE) is a professional and technical society that has been involved in the electricity industry for over 125 years.

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