



Why are we out here?

In which, setting out upon the next legs of our odyssey, we gather to speak of the wonders and benefits we hope to find.

We're now well into our voyage in search of exergy. We've identified our prime waypoints (the eleven laws of classical physics), closely circled one (conservation of energy), sailed into a little cove for mid-voyage provisioning (to talk of equations and metaphors), and now we're back on the high seas. The first evening of an ocean passage brings excitement tempered by apprehension. So as the glitter of late afternoon changes to the chill of night, let's brew a cup of something hot and sit round the cockpit to speak of why we're out here.

We began our journey when reminded that energy is never consumed [1]. Rather, something-of-value is extracted from energy flows. We named that something-of-value "exergy" and set out to find what it is. Now, to sustain us through the night-watch and the prospect of difficult sailing over the days to come, some of our crew are asking, why should we care? What will it bring?

These next legs of our voyage will first take us to the entropy waypoint and then on to exergy. We must find entropy before we can get to exergy. Yet even before we reach exergy, the ideas of entropy itself will bring a better feel for how Nature works including how Earth works and how we work—stirring curiosity with a new optic for wonder about what we really get from food . . . about what could be the essence of aesthetics . . .

Then, when we reach exergy we'll find it gives us a sharper view of our energy system, of what it harvests, what it delivers and how its delivery systems can be improved. While entropy's prize can be delight, exergy's prize is practical—can help us make money, create jobs, clean the place up, improve public policy.

Entropy and exergy themselves aren't the prizes. They're the tools we need to win the prizes.

Still, why should we care? To give one reason let's consider food—say pop tarts. Why do we list energy content of pop tarts on a pop tarts package? Earth doesn't consume energy, neither do we, nor does anything. So what's so important about the energy of pop tarts? Truth is, not very much!

Perhaps the most valuable commodity we get from food is "structure". We mine structure from food—from carrots, fish and walnuts—and use it to build structure into our bones and muscle—even into our thoughts. To understand why we work this way, we'll need the concept of entropy. Then we'll understand why we eat low-entropy (structured) foods and rid ourselves of high-entropy (mushy) wastes.

Perhaps food packages should list the food's entropy content. This won't make much sense now. But I hope it will make sense after we've got to "*Leitmotiv* of Living Planets" [2]. And when it does, we can have fun thinking about what we really eat when we eat, what we really poop when we poop—and why we like some things, like gardens and symphonies, but not others.

Now let's talk about the prizes exergy can deliver.

When we've built so much of our thinking, public policy and industrial strategies on ideas like energy security, energy shortages, energy sectors, energy efficiency, energy technologies and energy systems, it's unnerving to realize we haven't had the real issue in focus. We may have been close, *must* have been close or our civilization couldn't have come so far. Yet we've been missing the bull's eye—often by wide margins. But now, as the bonds tighten around energy systems, planetary health and economic health, we better be sure our choices are based on a clear view of what's happening and what's possible.

Another of exergy's gifts is the ability to calculate *meaningful* efficiencies. To be illuminating, efficiencies must compare a technology's inputs and outputs in terms of exergy, *not* energy. But today efficiencies are normally calculated in terms of energy ratios and therefore the results (in terms of what "efficiency" is understood to mean) are frequently wrong—sometimes terribly wrong. Energy-based efficiencies routinely (albeit unwittingly) confound public policy—and too often confuse engineers. They also provide a wonderful loophole for those who would mislead.

Another exergy prize is finding useful tasks for energy currencies that, too often, we now throw out as waste. Frequently, the waste from one task will be just right for a different task. By thinking in terms of exergy we often

find new opportunities (like integration and delivery of multiple services) staring us in the face—opportunities previously hidden below the murk of our obsession with energy.

Exergy is a great optic for seeing what's happening, what's possible—and especially what's *better*.

These are practical reasons for this trip. Yet my intention is not mere practicality. It's also to help us better enjoy the wonders of watching Nature tick. We'll find some of these wonders in the "The Arrow of Time" [3] and the "*Leitmotiv* of Living Planets" [2]. Still for me, the most fascinating may be the wonders we'll be equipped to ponder as we conclude our voyage in "From Steam Engines to Symphonies" [4]—because what *really* makes the next few legs of our odyssey worth the challenge is how they'll give new ways to enjoy the extraordinary marvels of our extraordinary planet.

The forecast says morning will bring strong winds on the nose. But now we have a better idea why we're out here.

This is the fifteenth in a series of articles by

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References

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- [4] Scott DS. From steam engines to symphonies (25th in this IJHE series). Int J Hydrogen Energy, in press.