

Analysing Energy Substrates Through Conversion Efficiencies And Embodied Energies

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Christopher Kalitin Blog (<https://ckalitin.github.io/posts/energy-substrate-conversions/>)

Summary of notes:

- Transport layer: Compare conversion efficiencies into the transport layer and out of it, and transmission losses.
- What is any energy substrate? A substrate is a medium through which energy is transferred. The underlying layer connecting all loads and sources, transmission layer.
- A prime mover is the final step in the energy transfer process, potential into end-use mechanical energy.

Modelling idiot index & embodied energy:

- Model relative merit of different substrates for different applications (eg. jets very different from dryers).
- Model embodied energy of conversion machines (find better word than machines, mechanism?) and amortize energy costs.
- This is distinct from idiot index, we can create an energy idiot index? Energy input vs embodied energy of final product. This is storage efficiency. Eg. for synthesizing hydrocarbons.
- Embodied energy and energetic idiot index still doesn't cover everything that pure dollar cost does. Energy of extraction might get us closer.
- If I do model every single energy conversion and efficiency in the full stack, will I arrive at the same conclusion as modelling cost? I'm assuming that the energetic idiot index decreases with more advanced technology, like cost declines. Find source data on if this is true or not.
- I've never seen anyone think like this ever before. Extremely fundamental analysis.
- Create a high-level enough architecture that it can be applied to any energy problem. Eg. the shift from chemical to electrical energy in transportation. This will help to uncover what substrate will be next to change.
- Another project I need to do is modelling energy sources into the future. Ie. solar, and the elements of solar cost, and what batteries actually do on the grid. Batteries are the most

important project for me to do, megapack. Figure out grid dynamics, watch talks and podcasts.

- It's possible to write this blog post in a way everyone understands, be explicit in the quest to do this. Simplify to explainable levels.

Substrate in engineering: In materials science and engineering, a substrate refers to a base material on which processing is conducted.

Think more about everything in terms of energy. Electrical energy can be turned into any other kind of energy. Examine other forms through their conversion mechanisms.

There's a first principles analysis to be done here where you compare all forms of energy as the fundamental energy transfer mechanism for the world, look at it through transfer efficiency.

There's a shift from chemical to electrical going on, maybe you can find some fundamental principle to describe this. Maybe it's at a deeper level than capital efficiency, maybe it goes down into energy efficiency as well.

Cost coming down means idiot index decreasing, you can model this as conversion efficiency (but of what into what?)

Edit: it's embodied energy of the conversion machines, amortized energy

Different substrates (prime movers) embody energy transfer.

Eg. Draft animals are chemical energy machines (citation needed) that convert chemical energy into kinetic.

There are forms of transferring kinetic energy (early factories), high transmission losses (maybe conversion losses too?).

You can have a new prime mover operating in the same energy domain. Eg. Draft animals to turbines was still all chemical into kinetic.

My analysis could be looking at different uses of energy and comparing different energy sources and embodiments of those sources.

Eg. Grain milling requires kinetic energy to crush the grains into flour. Look at the full stack energy efficiency of different sources and intermediary energies. (Eg. Nuclear to electrical to kinetic)

Need some way to generalize

This definition says a prime mover turns potential energy into mechanical energy:

<https://en.m.wikipedia.org/wiki/Engine> (<https://en.m.wikipedia.org/wiki/Engine>)

So a prime mover is located at the final step? The transfer to kinetic energy? This definition is of engine, not prime mover. Redirected from the prime mover Wikipedia page Well that page says the same. Conversion of any form into mechanical Mechanical energy depends on position and motion. Kinetic is only motion Mechanical = kinetic + potential

Also compressed air as a transmission mechanism, mostly at smaller scales