ENERGY AS ENCLOSURE

Of all the weighty political issues of the day, there are probably few that are not connected with energy. War in the Middle East – *energy*. Global warming – *energy*. Conflict in Nigeria – *energy*. Infrastructure investment – *energy*. Economic growth – *energy*. European security – *energy*. Peak oil – *energy*. And the list goes on.

What is all this "energy"? We usually take it for granted that we understand the concept. But do we? And if we don't, is that a problem?

To my shame, I have to admit that environmental activists like me aren't usually much help in explaining what energy is.

Stephanie Rupp, a US-based anthropologist, recently encountered some green energy activists who had taken to the streets of New York City to try to enlist pedestrians to the cause of decreasing the city's oil consumption and generating more of its electricity from renewable sources. The activists were young, enthusiastic, determined and articulate. Although they were having a hard time persuading hurrying passersby to stop and listen, few would have doubted that they had a clear idea of the future they were fighting for. Yet when Stephanie asked them what energy *is*, the twentysomething activists were suddenly brought up short. There was a stunned silence. Finally one of them gushed, "Energy is whatever powers whatever we do. Energy is … so, so *much.* Energy is … that's a good question. Energy is … is … *everything!*"

The young activists were not alone in being floored by the question. Many of us would probably have a similar reaction.

Yet there is at least one group of people who would probably not be fazed by the challenge: physicists.

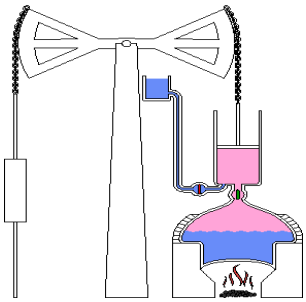
Physicists have good reason to be confident that they, at least, know what energy is. They invented the concept. Before 1800 no one talked about "energy" in

the modern sense. By 1850 a lot of people did. This was due at least partly to the development of the science of thermodynamics.

So I suggest that if we want to know what energy is, we listen carefully to what the thermodynamicists said (some of them are pictured above).

One of the most interesting things they said was that energy was all about *labor*. They organized the energy concept that they helped to develop around the idea of something that could be translatable into *work*.

And by work they meant *industrial* work. What impelled and inspired the thermodynamicists was the study of *engines* – in particular, proto-industrial engines at the dawn of the fossil fuel era: how to make them do work; how to make them do it better. Their contemporaries were engine developers; and what got the engine developers going were business possibilities.

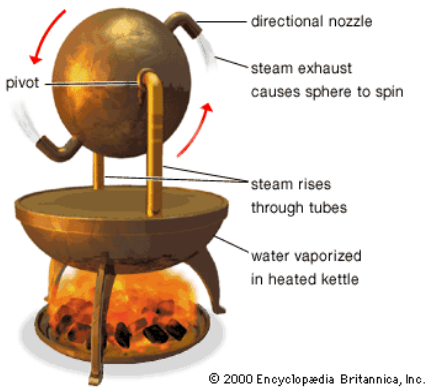


Now the reason I'm spelling it out that the "work" that the thermodynamicists were interested in – and in turn helped to conceptualize – was *industrial capitalist* work is that, both at the time and after, capitalist work was not the only kind of work there was.

Wage labor had of course been a reality for centuries. Probably before 1600, the meaning "paid employment" had already been added to the cloud of other senses surrounding the word "work". It had been around 1750 that the term "work" came to mean an *aggregate* of concrete activities. But only around the time of the thermodynamicists did the concept of commodifiable labor-power really come into its own: an abstract, saleable, homogeneous fluid that was measurable in units of time and that could even be treated as a measure of value – a fluid embodied in a proletariat that was still emerging.

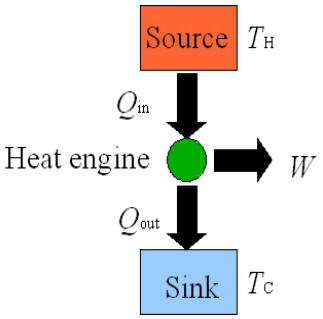
Indeed, although "wage labor" has come to dominate the meaning of "work" in modern European languages, other, more venerable meanings continue to haunt the term. This multiplicity is perhaps clearer in some other language families. In Thai, for example, as in European languages, the word for "work" – in this case, *ngaan* – has come to denote "productive" waged labour. But it also simultaneously continues to signify a wide range of things that we in Europe might call by other names – *sui generis* festivals, rituals, religio-agricultural practices, commons activities and other pursuits that have nothing to do with capital accumulation. *Ngaan taengngaan* is a wedding, *ngaan sope* a funeral, *ngaan wat* a temple fair, *ngaan chalong pii mai* a New Year's celebration, and so on. (And incidentally, *phlang ngaan* is a neologism meaning "energy".)

The point is that the thermodynamicists were not interested in – and did not help to develop – any of these *other* meanings of work or human activity. They could no more conceive of their heat engines being used for subsistence, comfort, the remediation of human weakness or just plain fun than Hero of Alexandria, in the first century AD, could have imagined using the famous "toy" steam engine that he invented (left) for purposes of capital accumulation.

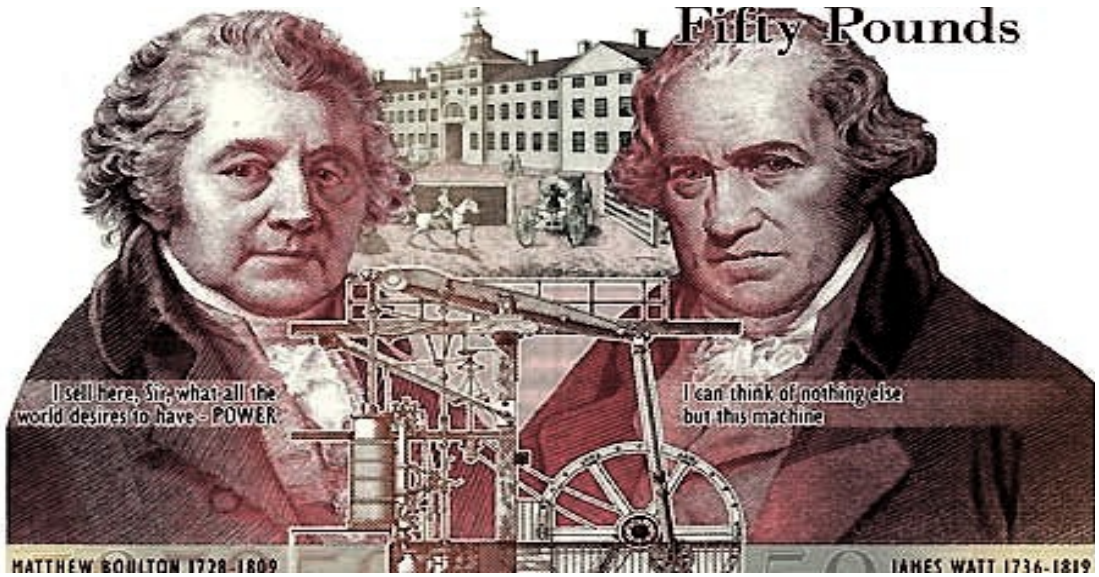


Instead, the role of the thermodynamicists was, to borrow the words of George Caffentzis (who will be speaking this afternoon), "to provide models of capitalist work". The important point to remember is that, as historian Theodore Porter puts it, "an *economic* point of view formed the root of thermodynamics … Economic and physical ideas grew up together, sharing a common context".

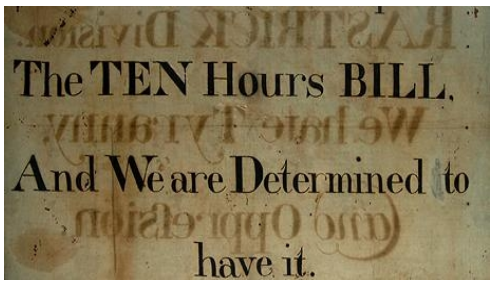
This is clear enough even from the idealized heat engine that Sadi Carnot studied. In the diagram (right), if Q is heat, W is *work*. And if "work" in this context is formally defined as the ability to lift a certain weight over a certain distance, the connection with capitalist work is not hard to find.



Such heat engines had already been embodied in such inventions as Thomas Newcomen's clumsy early 18th-century steam engine, which was used to pump water out of coal mines. But they were developed much further with the rotary steam engines that made James Watt such a capitalist icon that he, together with his business partner Matthew Boulton, are pictured today on the reverse side of the UK £50 note (complete with quotations revealing the obsessiveness of both).



At the dawn of the industrial era, steam engines were unpopular with cotton manufacturers in the UK. Water power was a lot cheaper and less prone to breakdown. But when the struggle of workers to limit the legal working day to 10 hours succeeded, cutting the productivity of dispersed and far-flung water mills where mechanical energy could not be reliably guaranteed 24 hours a day, capitalists needed a new weapon to squeeze the maximum value out of labor. As the Swedish sociologist Andreas Malm recounts in a brilliant series of recent papers, coal-fired steam engines fit the bill, and were called out of the obscurity in which they had lain for several decades. Unlike waterfalls, which were spread out over the hills, steam engines could be placed in the middle of towns, where it was easy to procure labor that was, in the words of one apologist for business, "trained to industrious habits".



Fuelled by a seemingly limitless, powerful, transportable fuel, steam machinery helped capital concentrate workers. By doing so, it also helped capital make good on its perennial threat to discard workers who did not come up to the proper standards of obedience, and hire others. No longer tied to particular (remote) places nor to the cyclic rhythms of the day and the seasons, machines became a more effective tool than they ever had been before in business's enduring struggle against labor. Steam-powered factories were also better at micromanaging labor at minimal cost, through what Karl Marx evocatively called the "closer filling-up of the pores of the working day." The machine/labor combination – or, to use a more up-to-date term, the working cyborg – was now able to produce much more surplus for owners over a wider geographical range than ever before.

A century later, of course, another kind of heat engine, the internal combustion engine, became central to capital in other ways. For example, it allowed the development of suburbia, which was a new way of absorbing surplus capital, as well as enabling what geographer Matthew Huber, who will also be speaking later today, calls the privatization of reproductive work.

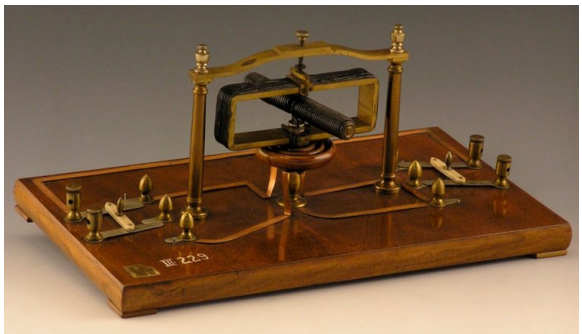
But the full extent of the connections between the development of capitalist work and the development of the energy concept emerges only from looking at history in even more detail.

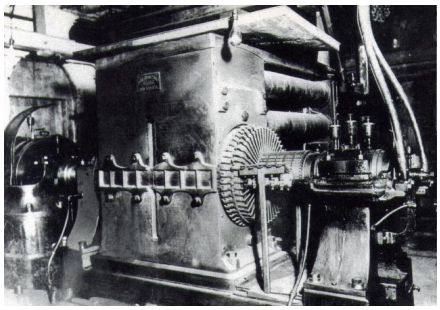
I've described the way that steam engines abstracted from place and from the cyclical time of days and seasons, allowing capital new freedom and power over labor. But there was another kind of business-friendly abstraction going on here as well. The new concept of energy was *itself* an abstraction from multiple, specific "energies", which had tended as a rule to be more closely entangled with the ways of subsistence and thus less mobile and less available for capital accumulation.

The First Law of Thermodynamics, for example, helped commensurate heat and mechanical energy. In some sense, it helped "make them the same". It said that there was something

common to both that was conserved when an engine converted the one to the other. And that something could be measured: In the 1840s, Julian Robert von Meyer and James Joule calculated the “mechanical equivalent of heat”, Meyer insisting that an immaterial entity called *Krafte*, forces, could undergo metamorphoses. “The quantity of their entities is invariable,” he said, developing an old idea of Leibniz: “only their quality is variable.”

Later on, further equivalences were developed, both in industrial capitalist engineering practice and in energy theory. In the 1830s, the first electric motor (left) embodied the convertibility of electricity into mechanical energy. In the 1860s, the dynamo made real the convertibility of mechanical energy back into electricity, completing an equivalence that was only really cemented over many decades, beginning with developments such as Thomas Edison's 1882 Pearl Street generating station in New York City (right), which heralded the electric grids later to dominate all industrialized countries.





Putting such connections together yielded longer series of practical equivalents, for example:

Thermal (heat engines) → mechanical (turbines) → electric (wires) → magnetic (electric motors) → mechanical (crankshafts)

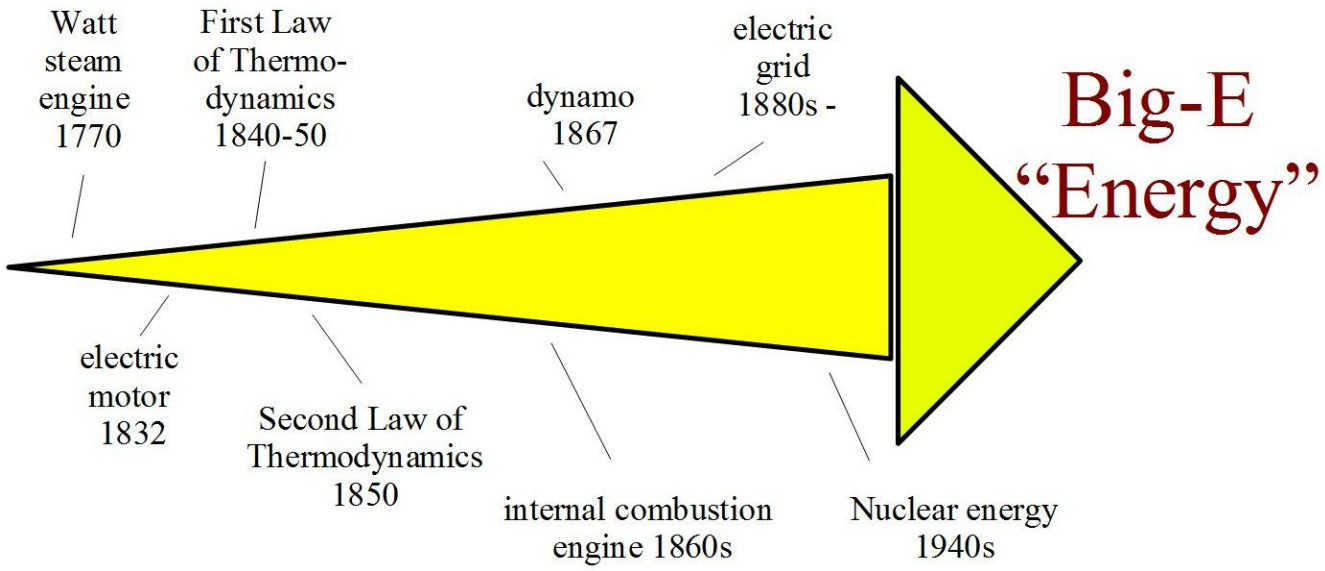
And the conjoined efforts of capitalists, engineers and scientists soon made even longer chains of equivalences manifest:

Thermonuclear → electromagnetic → biochemical → thermal → mechanical → electric → electromagnetic → mechanical

These various things were made convertible to each other not just by theorists sitting in a classroom or laboratory marking equals signs on a blackboard. Most of them were also made equivalent by the contraptions of iron, rubber, gutta-percha, copper wire, coal and reinforced concrete associated with the infrastructure and social organization of industrial capital accumulation.The result of all this practical work of “making different things the same” was a gigantic, open-ended abstraction called “energy” (below).

The word came to signify a special abstract something that had been detached or disentangled from what now seemed to be merely specific instantiations: fire, motion, magnetism and so on. This special abstract something could be made the special property of whoever had liberated it,

and mobilized and used in whatever way its owner wanted. Energy was, to borrow words that Marx used in the *Grundrisse* to describe the commodification of labor, “an abstraction which became true in practice”.



Given where we middle-class Europeans are today, it probably takes a historian or anthropologist to make us understand what a radical step this abstraction was. As historian Joel Mokyr has written, the equivalence of different forms of what we now call “energy” “... was not suspected by people in the eighteenth century; the notion that a horse pulling a treadmill and a coal fire heating a lime kiln were in some sense doing the same thing would have appeared absurd to them.”

And like the commodification of labor, the emergence of this “Big-E Energy” both enabled, and was enabled by, accelerated capital accumulation. The Big-E Energy we know today is a transformation and commensuration of specific energies into a general capacity to maximise the ability of human bodies to make stuff. No wonder that, as George Caffentzis puts it, “the infinite multiplicity of energetic forms inspired a tremendous optimism in capital's search for new workforces”.

In essence, the abstraction processes that have resulted in today's energy concept – Big-E Energy – are ways of overcoming refusal of and resistance to capitalist work. They are connected both with strategies to separate people who are not yet workers from their sources of subsistence, to enclose their commons, deny them the right to live, and make them into wage laborers; and with strategies to gain more power over, and discipline more deeply, those who are already laborers. Energy as we think of it today in Europe is embedded in capital accumulation.

However, there's still one huge thing I've mostly left out of the story of how today's Big-E Energy was created: fossil fuels.

It was the addition of fossil fuels to the combination of heat engines and commodified labor that really entrenched the abstraction that is Big-E Energy deeply into world politics.

After all, in a very superficial sense, Hero and his toy steam engine, together with the metalworkers that put it together and the wood that fuelled it, had already commensurated heat and mechanical energy 1,750 years before. But only with the huge concentration of power in coal, oil and gas – derived from hundreds of thousands of years of plant and marine life growth – could either the wage labor relation or the commensuration and commodification of different kinds of energy have ever become so generalized worldwide, and the illusion of "infinite economic growth" so easy to accept.

The widespread use of big machines fired by fossil fuels was key to the commodification of, and control over, labor power. Only with fossil fuels could the machine become, in Marx's words, "not only an automaton but an autocrat" – an agent that allowed greatly increased control over the pace and organization of what workers did and thought.

Marx famously taught us to look at industrial machines as frozen or "dead" labor. But machines cannot be run without fuel; and the machines of the era of industrial capital could not be run without fossil fuels. Otherwise they were just a pile of junk.

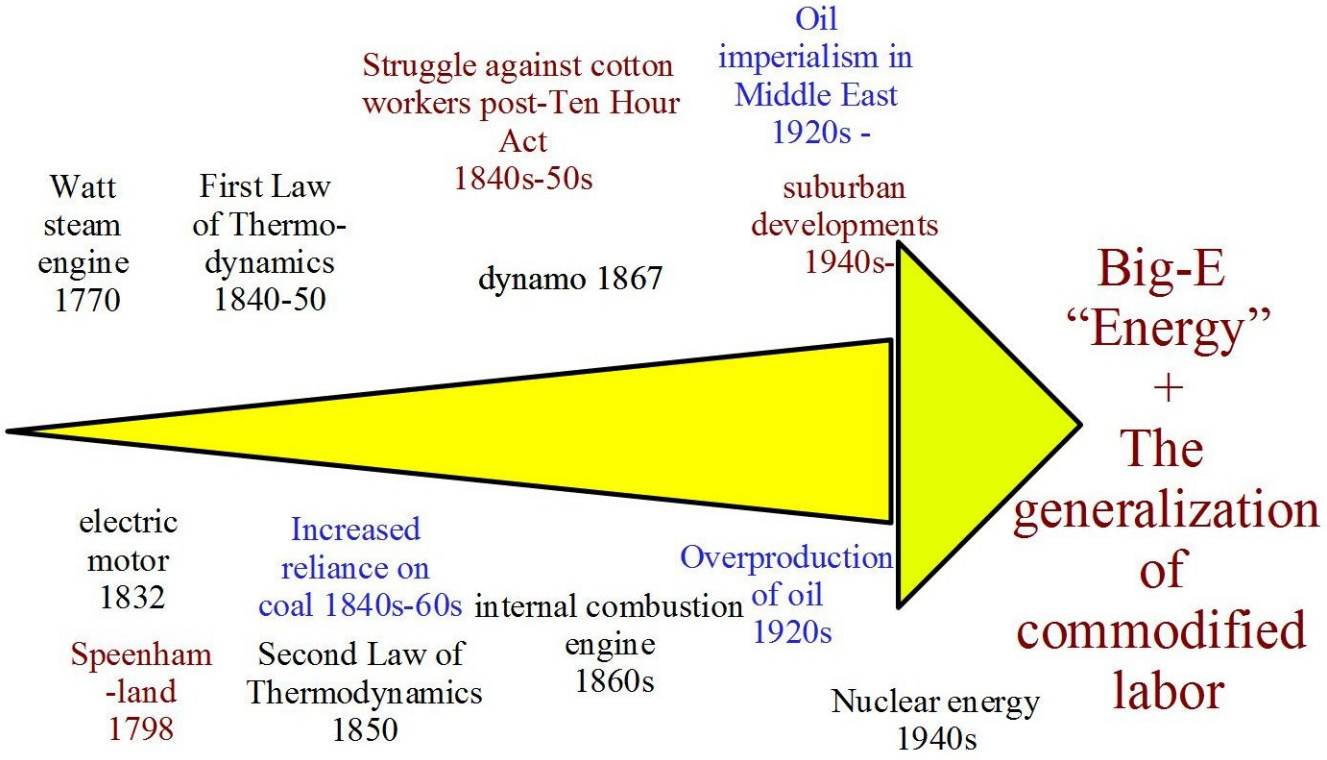
So in a sense these machines are not just dead labor. They are also, in a concept I am borrowing from Matthew Huber, *dead ecologies*. They rely on the "work" of untold generations of past nonhuman life. One of the reasons the new machines could disregard the circular time of the days and seasons was that they ran by transporting the products of photosynthesis from past eras to a single point in the present, commensurating biological activity of different ages and allowing energy to be accumulated and deployed in unprecedented quantities. Today, 400 years' worth of plant growth are burned every year in the form of coal, oil and gas.

Thus the process of assembling this abstraction that we now refer to as "energy" has always been connected not only with work and the commodification of human activity, but also specifically with the use of fossil fuels.

So it is not that there has always existed some primordial need for "energy" which just happened to be filled one day by fossil fuels. Fossil fuels themselves played a crucial part in creating the very concept of scarce "energy" that use use today.

Which means I should now fill in a few of the things I earlier left out in my big yellow arrow tracing the emergence of Big-E Energy (below).

What are the implications of all this for environmental activists like me? The central



implication, I think, is that it is a critical part of political strategy not to treat "energy" as a neutral thing that has always been there and which human beings have always craved. Energy is a particular historical phenomenon inextricably tied up with unequal exchange. Not surprisingly, it has very important inbuilt political biases. If what Andreas Malm calls "fossil capitalism" has defined what we *mean* by "energy", then merely to use the word uncritically is to make a commitment to certain assumptions about scarcity, foreclose certain alternatives and cover up some of the most important issues that need to be discussed.

For example, we've grown accustomed to thinking that fossil fuels are "one form of energy" (and therefore that they could be "replaced" by another form). We're tempted to believe that maybe we can get the Big-E Energy we need without coal, oil and gas, or without something like them. But what the history of Big-E Energy tells us is that it's more the other way around. The modern concept of energy came out of the use of fossil fuels – or, more precisely the way fossil fuels have been fused into industrial machinery in the long battle capital has waged to continue to extract as much value as possible from ordinary people. Hence instead of asking questions like "How can we have energy in a post-fossil world?" it might be more fruitful to ask the question "Is the world that is defined (in part) by the modern concept of Big-E Energy the world that we want?"

Similarly, we've grown accustomed to thinking that perhaps the political problem with Big-E Energy is merely that it needs to be distributed fairly all over the world. But the history of Big-E Energy tells us that Big-E Energy is *based* on inequality, and that the more it dominates, the

more inequality there will be. To interpret popular struggles over energy as if they were all about getting “equal shares” of Big-E Energy is to miss most of what is important about this politics today, and to overlook the most important opportunities for alliance-building.

Among us urban-based Europeans, it is often hard to grasp the political and scientific biases in the concept of Big-E Energy without attempting to contrast the energy practices that we know best with other practices that have generally had no generic name, and to which Big-E Energy is implacably opposed. This act of contrasting, of course, carries the risk of erecting silly binaries in our and our interlocutors' minds, and of inviting silly questions like “Is this really an alternative?” – as if political action consisted in the implementation of intellectuals' plans, or as if what I have been describing as revolving around Big-E Energy is anything other than an already-existing worldwide struggle. Nevertheless, rough contrasts are often a starting point toward a wider perspective.

For example, it is fair to say that it is a characteristic of abstract Big-E Energy that there can never be enough of it. It is scarce in principle. By contrast, plural, vernacular little-e “energies” (which of course do not ever go by that name) that are particular to specific commons practices tend to be self-limiting. There may sometimes be a dearth of these “energies”, but it is not the case that human beings are always impinging on them in a hostile, Cartesian or Malthusian way. They are not scarce, and the Second Law of Thermodynamics holds no terrors whatsoever for those who rely exclusively on them.

Take, for example, the attitude of a Southeast Asian villager using dead wood from a local common woodland in order to cook some rice. Typically, she would not regard herself as using an abstract “energy”. And for her, it would be crazy, antisocial, and disrespectful to use more wood than was “just enough” to cook the meal. Yet there need also be no reason to regard the wood as “scarce”, provided that the local woodland was treated and conserved by the community as a “dead wood commons”.

Now contrast this villager with a government energy planner. For the planner, energy is something abstract. It might be coal, hydroelectric, nuclear, whatever. It might be used by a steel factory, a hospital, a bus fleet, whatever. From the planner's point of view, there can never be enough of this abstract energy, because its purpose – economic growth – is also abstract, as well as being in principle unlimited. It will always be scarce.

In practice, the villager and the planner are likely to find themselves at odds. The planner's Big-E Energy will be in conflict with the villager's little-e energies. For example, the hydroelectric dam or oil refinery that the planner proposes to meet an abstract, hypothetical “energy need”

may destroy the common woodland from which the villager gets her cooking material.

A similar type of conflict will arise between Big-E Energy and many of the practices of indigenous peoples that are also sometimes translated as "energy". For example, for the state energy planner, promoting domestic oil or coal extraction may be a part of providing "energy needs". Yet for many indigenous peoples, including in Latin America, taking oil out of the ground actually *interferes with*, *diminishes* and *blocks* the energy associated with the earth, both in particular places and more generally.

Another way of putting this is to say that the idea of a "green" Big-E Energy is, in some sense, a contradiction in terms. An "Energy" which derives from fossil capitalism has an internal dynamic opposed to climatic stability and the maintenance of livable surroundings.

The same holds true for the phrase "Energy justice". Little-e "energies" of various kinds may well hold out the possibility of justice, and so for indigenous "energies". But – as I take Ivan Illich to have already pointed out 40 years ago – Big-E Energy will always have an opposed dynamic.

For me, this suggests that the most important and promising progressive alliances around energy in the future will not be among governments, corporations and NGOs who are hoping somehow to develop a "green" or "fair" Big-E Energy. It will, rather, be among all those who are united in a refusal of or resistance to what George Caffentzis calls "capitalist work" – from peasants or indigenous peoples fighting the enclosure of commons to urban dwellers who have had enough of falling wages, austerity and financial robbery. Such movements will be following strategies that superficially may seem different. Some will be seeking to defend existing commons and sources of subsistence. Others will be constructing new commons and means of subsistence on the structures that Big-E Energy represent. Underneath, however, the struggle is very much the same.

The fact that many such alliances are still to be made does not detract from their potential; at most, it indicates a temporary shortsightedness. As always, worlds are being won every day, but there are also worlds still waiting.