Energy, Work and Finance

March 2014

THE CORNER HOUSE

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The Corner House aims to support democratic and community movements for environmental and social justice, paying constant attention to questions of social, economic and political power and practical strategy.

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Introduction: Energy, Finance and Change

On the Streets of New York City

One fine autumn day in 2009, several young, enthusiastic green energy activists took 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. Unsurprisingly, the activists didn't have an easy time persuading hurrying passersby to stop and listen. But they were both determined and articulate, and few would have doubted that they had a clear idea of the future they were fighting for.

Yet when one pedestrian stopped to ask 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!*"[1]

Environmental activists in New York City are not alone in being floored by such questions. If no one asks us, many of us who were born into industrialized societies may feel we know perfectly well what energy is, at least as we experience it in our daily lives. We know we need energy to cook, keep warm and communicate. We need it to get around, light shops and homes, build things, and transport and preserve food. We know the companies that provide it are often very powerful, and businesspeople and politicians are obsessed by it. We know all about coal, windmills and electromagnetic radiation. We're used to seeing people buy energy drinks and worry about calories. If we've had a little schooling, we can even decipher equations like $E=mc^2$. Pressed hard, we can imagine what it might be like for energy to be green (it would be generated renewably!) or cheap (petrol would be a Euro a litre and we would have more to spend on other things!) or more justly distributed (everybody would have enough fuel and electricity for basic needs!). Yet we too might react with confusion if asked what energy actually *is*.[2] Given that we seem to know so much about the subject, what is it that makes the question so unsettling?

Perhaps the question is unfair or pedantic. In Charles Dickens' novel *Hard Times*, a little girl named Sissy, whose father rides and tends to horses in a circus, and who has been around horses all her life, is bullied and accused of ignorance by the pompous utilitarian schoolmaster Gradgrind because she cannot define what a horse is. Is it equally unjust to ask environmental activists what energy is? Perhaps such questions are just an irritating waste of time when so much urgent action is needed to bring electricity to the deprived and heat to the elderly while at the same time preventing runaway climate change.

But then again, perhaps it *matters* if "green energy" or "energy democracy" campaigners find it hard to explain what energy is. There is an uncomfortable yet hard truth haunting all contemporary discussions about energy policy – namely, that today's dominant concept of energy is itself a political problem.

This concept – call it Big-E Energy[3] – signifies the energy of thermodynamics, of electromagnetism, of the fusion of heat, motion and electricity in steam engines, turbines, dynamos, electric motors and electric grids. It stands simultaneously for photosynthesis, nuclear, solar and muscle power, and the force generated by the internal combustion engine.

At first glance the idea of an "energy" that unifies all these phenomena may seem innocent and obvious, and what it designates neutral and eternal. Surely, it will be said, this "energy" is merely one aspect of the universe and its laws. Surely it is merely a condition of existence that, like food, water and shelter, everybody needs, and has always needed, whatever their status in society. The only question, it seems, is how to get however much we need and want of this energy without wrecking the earth and, insofar as is possible, to make sure it is shared around fairly among everybody.

But things are not so simple. A more nuanced perspective reveals this notion of "energy" to be neither innocent nor obvious, neither eternal nor politically or environmentally neutral. Big-E Energy is a historical product that emerged during a long and variegated struggle by elite and industrial interests against ordinary people whose activities they sought to regiment and exploit for profit. Although it can incidentally be used for a multitude of subsistence tasks, Big-E Energy is not a magical substance devised to relieve poverty, keep grannies warm and light up rural schoolrooms. It is, rather, above all a means for making labour more productive and for controlling and exploiting it. In a sense, this "energy" is fallout from a particular two-century episode in an even longer political story of privatization and commodification of work and land that continues today. Like so much else in this story, Big-E Energy's dynamic is inherently destructive of soil, water and air alike.

Like witch hunts, workhouses and steam engines, Big-E Energy belongs to a particular historical period and to particular places and their particular battles. To be understood, it must be put in the context of its times – political, social, environmental. If it is true that – in one form or another, and for better or worse – Big-E Energy is not going to go away, that is not because it "has always been there", any more than assembly lines or genetic engineering have always been there. It is merely because the materials created by history are what the future must work with; as the US novelist William Faulkner once said, the past is never dead; it is not even past.

The story of energy is a story of resistance as well as aggression, of accommodation and adjustment as well as exploitation. Existing alongside and even inside the practices of Big-E Energy that have been evolving since about 1800 are a galaxy of oppositional or coping practices without a generic name, often organized around defence of common land, common water, and the endless variety of activities pursued by human beings to support subsistence. One could say that such practices form a shadow to Big-E Energy. More: they are often even "anti"-Big-E Energy (they might even be called "little-e energies") – except that they grow out

of something that is much older than Big-E Energy, and always maintain a presence even where Big-E Energy is absent. Telling the energy story means telling their story as well. Understanding Big-E Energy means understanding them as well.

Thus behind the vague "front story" of energy that we all know – energy the "labour saver", energy the source of creature comforts, energy the all-pervasive background that seemed to the young New York activists to be "everything" – is a more complex "back story"[4] full of characters that are not always recognized or even named as supporters or foes of the Big-E Energy whose development they have continually shaped. This "back story" has only just begun to be explored. The most the present report can do is suggest how big it is. Figure 1 is a stab at indicating the rough scope of the tale in visual form, and the next section, "Energy as Struggle", sketches in a few details. But exploring what today's "energy" really is – together with its shadows, precursors, successors and alternatives – will remain a work in progress.

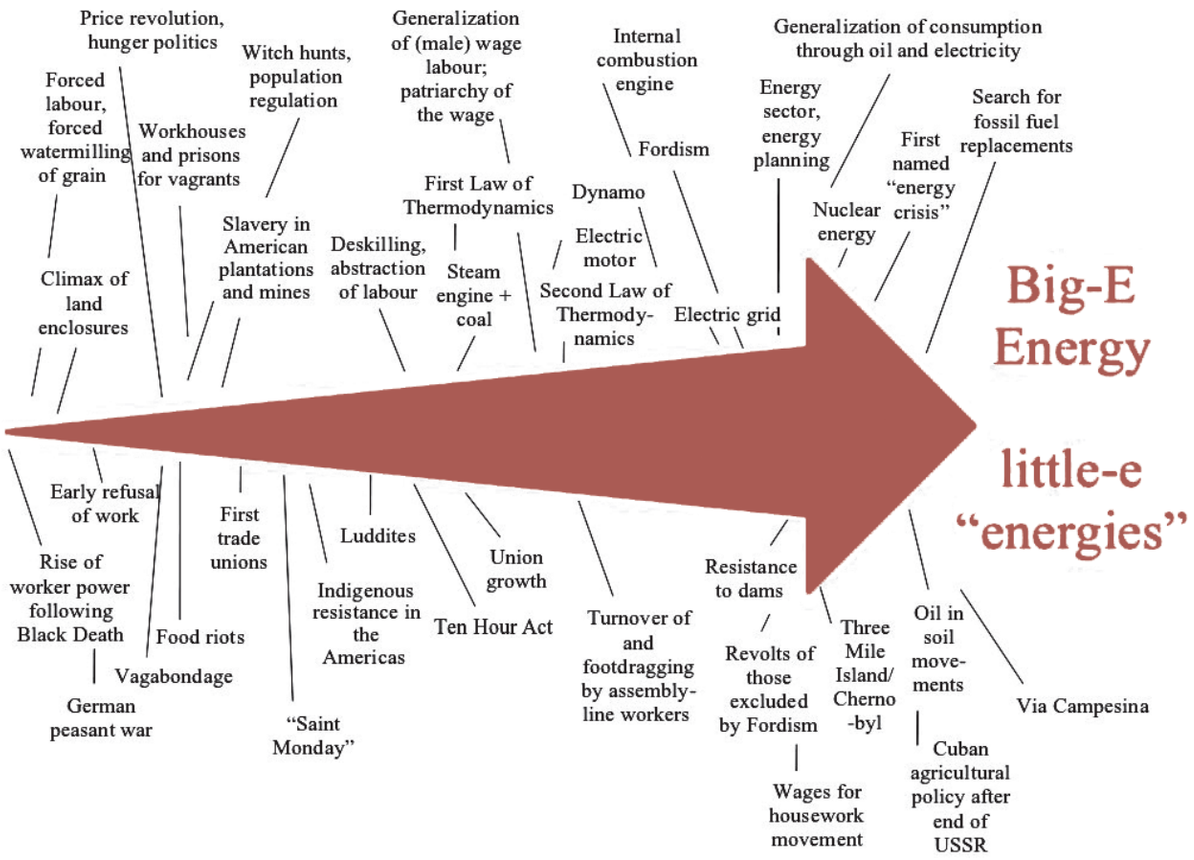


Figure 1

As the rest of this report will argue, such excursions into the past and the future – and into the full geographic range of energy practices – are likely to be increasingly essential for effective activism about energy policy. Without some historically-informed conception of the political and ecological biases of dominant energy concepts, activists who campaign for "green energy" funding, or for "energy democracy", are unlikely in fact to have much idea of what they are asking for. Their demand for "green energy" can turn out in practice to be not much more coherent than a demand for "green global warming", "green pollution", or "green oppression". Their demand for "energy democracy" may become, in effect, a self-contradictory call for "unequal democracy" that plays straight into the hands of an energy establishment looking to legitimate business as usual. Concentrating only on the word "alternative" in "alternative energy plans", while neglecting the word "energy", can back them into a corner they might not want to be in, perpetuate types of oppression and environmental destruction they might not want to be a part of, and make enemies they might not want to make. As the saying goes, one should be careful what one asks for, lest one gets it.

Worse, without some grasp of the back story that makes Big-E Energy what it is, the opposition that coevolves with it will remain invisible; and if that opposition remains invisible, so will most of the political and social power that activists need to draw on in order to succeed in the battle for a livable energy future. Activists may end up unwittingly taking sides against potential allies whose support they need – for example, community activists opposing giant wind developments in their localities, indigenous groups seeking to keep oil in the soil, or movements defending family farming – instead of building the necessary alliances with them. They may not even be aware that such groups *are* potential allies, frittering away opportunities for movement-building before they are even recognized. Slowing down and asking what energy *is*, then, is not a distraction from, but a prerequisite for, the careful alliance-construction that the current moment requires.

Pots of Money

If discussions about how to fund a livable energy future cannot afford to overlook the destructive and antidemocratic dynamic contained in Big-E Energy itself, neither can they afford to assume that finance is nothing more than a politically- and environmentally-neutral pot of money. For sustainable energy activists to treat the problem of how to finance a transition away from fossil fuels as a matter of finding the PIN to a big bank account – and then belatedly trying to enforce a few "safeguards" about how the money is spent – is a recipe for political and environmental failure.

Politicians and corporate executives are generally eager to invite the oversimplified view that finance is a pot of money precisely because of how much economic reality it hides from view. Some insist that the money needed to fund a transition away from fossil fuels can come only from "more growth" based on those very fossil fuels. By doing so, they are able to disguise business's growing structural dependence on coal, oil and gas as its opposite – a project for long-term environmental recovery. They can thus avoid concluding that the dependence calls for ways of tackling the issue of capital accumulation itself.

Others, meanwhile, claim that an energy transition can be funded only by increased reliance on a private sector that has "cash to invest" that the state lacks. Doing so enables them to continue to push the post-1970s trend toward increased privatization and financialization as if it were a way of avoiding "inefficiency" and "waste" in the welfare state and harnessing the comparatively superior abilities of the private sector, rather than what it is – a strategy of reliance on financial swindles and large-scale robberies from the public as a way of compensating for falling profits. Pressing the claims of the corporate sector to be the legitimate arena for decision-making and action on an energy transition is a neat way of ensuring that the transition – and the end to growth it entails[5] – will never be undertaken. A multitude of reactionary political agendas, then, is advanced by the claim that "there just isn't the money available for an energy revolution".

The understandable retort of many environmentalists, of course, is "Yes, there is." Some point to the fact that there seems to be no lack of money for bloated militaries of dubious usefulness, particularly in the US. Why, then, is there a lack of money for, say, energy conservation or renewable energy? Others note that in 2008 and after, the states of industrialized countries were quickly able to mobilize many trillions of dollars in tax money to rescue private banks from the disastrous results of reckless experiments in gambling that had resulted in no public benefits whatsoever – a handout that in the US alone is ultimately likely to come to some US$13 trillion. Why take money that could pay for a new, low-carbon infrastructure in the US and use it to subsidize past – and future – financial swindles?

Both those who say there isn't enough money and those who say there is share a dangerous assumption. This is to accept the need to expand the supply Big-E Energy – an energy designed for endless accumulation of which, as will be argued in Section Two below, there can never be enough – as an unchallengeable given. Many environmentalists hope to find some way of colouring this energy "green" and "democratic", of somehow imposing workable "limits" on its expansion from outside, but seldom ask whether this is actually possible, or question the dominance of this conception of energy in discussions of an energy transition.

Trillions and Trillions

A natural consequence is that much of the strategic discussion about energy futures on both right and left tends to revolve around the word "trillions". It is said we need trillions in scarce money in order to buy new means of producing another scarce substance: green energy; trillions to "replace fossil fuels", "improve energy efficiency in the building sector", "build giant wind farms", "solve energy poverty" and so on.

"Trillions": the word seeps through the revolving doors of national treasuries and corporate headquarters, hangs like tabooed tobacco smoke in the open-plan offices of environmental organizations, creeps uninvited into the tents of Occupy activists, and rolls down city streets into municipal offices and chambers of commerce. Trillions entrench themselves in the pronouncements of the G-20 and the reports of Greenpeace and the OECD. Trillions rise in a dollar-denominated miasma over arrays of solar panels, droop over the blades of wind

turbines, hover over power lines and smart grids. Trillions smart in the eyes of anti-austerity activists, cruelly pinch the minds of urban planners and gag pensioners hard-pressed by rising electricity bills.

Two trillion dollars to "keep America's lights on"[6] – the equivalent of a pile of single dollar bills stacked 135,800 miles high or over halfway to the moon.[7] Twelve trillion to build the power stations, pipelines and electricity grids that corporate leaders "need" to keep their economies expanding.[8] (Make that $18 trillion if you don't want to fry from global warming – six trillion extra to incorporate the climate-friendly features necessary to keep average global temperature increases within "acceptable" limits.) Trillions more to improve energy efficiency – $13 trillion in the building sector alone.[9]

Still more mind-boggling are the trillions needed to ensure a supply of energy – energy of the kind needed for a global economy that grows by 3-4 per cent every year – *without* the use of fossil fuels. By one estimate, it would cost $100 trillion to effect a global transition to a wholly renewable energy system.[10] To put that figure into perspective, if you were to spend a million dollars a day for the next 200,000 years (just 50,000 years short of the time that *Homo sapiens* has been around as a species), you would still be left with a mountain of several hundred million dollars in spare change.

So common is the word "trillions", in fact, that to ask the question of what those trillions actually are would probably often draw the same shocked, frozen stares that the question "What is energy?" drew from the New York City activists. The question is unsettling. Surely, it may be thought, we know what dollars are! The only question is which ATM to get them from and how to divide them up and govern their investment.

A More Sophisticated View

Those at the sharp end of the "asymmetric distribution of resources and risks"[11] that afflict the global majority tend to have a different view. For them, a lot of the talk of "trillions" for an energy transition is worse than beside the point. A trillion dollars is not just an impossibly large number: it threatens the further entrenchment, not relief, of their marginalization, poverty and exploitation. The forced evictions and enclosures of forests, lands, rivers, seeds and fishing grounds financed by previous trillion-dollar "development" tsunamis – such as the Green Revolution – make a discussion of the linkages between energy, finance, dispossession and the generation of poverty imperative. For many groups in the global South, proposals for spending further "trillions" through the usual institutions have to take a back seat to strategies for stopping the *current* "trillions" from wreaking further damage to subsistence and equality. For them, it is simply naïve to believe that the question of how to organize energy generation and distribution can ever be tackled separately from the issue of what political and economic agendas to organize around.

The Congress of South African Trade Unions, for example, is explicit that addressing the energy issue is not so much a matter of numbers of dollars, transformers and solar plants as it is a matter of political change. It fingers capitalist accumulation as the cause of global warming and insists that any energy transition must be part of a wider programme of social, economic and political transformation.[12] A keynote address to the African National Congress meeting on energy as long ago as 1992 was exemplary in keeping the central issues in clear focus:

> "Our concern is not about the flow of electrons between the turbine and the switch in somebody's house. Our concern is primarily about the framework of democratic and accountable resource allocation."[13]

From such a perspective, it will be dangerous to assume that energy poverty is merely a lack of access to electricity, which in turn is interpreted as a consequence of too few power stations, green or otherwise, and that its solution lies in finding the money to build new generating capacity, off-grid or on-grid. Such assumptions can be found in the lengthy low-carbon energy proposals put forward by, for example, Greenpeace and World Wide Fund for Nature, which tend to address poverty only in the context of extending electricity connections.[14] Insofar as the impacts of energy and finance on poverty are recognised in such proposals, they are said to lie in the future and at the micro-level, the consequence of poor project implementation, a problem best addressed through environmental, and, to a lesser extent, human rights safeguards.

For more politically sophisticated activists, such an approach is inadequate insofar as, among other things, it obscures the reasons why electricity is so unequally distributed in the first place – privatization, the withdrawal of fuel subsidies, racism, class, low wages, dispossession, landlessness, and the accumulation of wealth by one group at the expense of others, as well as the dynamics of Big-E Energy itself. Such an approach also tends to foreclose discussion of the structural changes (land reform, for example) that may be needed if poorer communities, whether rural or urban, are to raise finance on their terms for energy technologies that they chose and that are suitable to their needs. At best, the trajectory is towards modernizing energy poverty, with smart grids and gleaming solar panels replacing older generating and distribution systems, but with subsistence still under assault.

From such a perspective, it will be crucial for campaigners seeking finance for an energy transition to be as versed in the "back story" of finance as it is for them to have some sense of the "back story" of Big-E Energy. They need to grasp that finance, too, is a set of active social movements always committed to innovation, but of a different kind – witness the invention, in a few short decades, of the trillion-dollar shadow banking system (*see* "The Energy of Finance and the Finance of Energy"). They need to appreciate finance's continuing support for fossil-fuelled mobility of production, just-in-time delivery systems, and, most important of all, labour control. They need to understand that they are up against institutions such as private equity funds that expect 20 per cent rates of return and will do what it takes to get them; to understand the part that the monetary system plays in the system of unequal exchange that keeps industry locked into fossil fuels; to grasp the dependence of the banking system on coal, oil and gas; to comprehend the dominant role private banks occupy in the creation of money itself; to have some sense of the over-the-counter derivatives markets whose outstanding nominal value currently comes to US$707 trillion;[15] to understand the "extractive" orientation of much current finance.[16] Nor will it do for energy campaigners to have so little understanding of investment that they simply parrot the assertion of large financial institutions that "all debts have to be repaid", even those pushed on Southern countries by Northern bankers awash with petrodollars or on indigent minorities in the US by Wall Street financiers hungry for market-beating "alpha" returns.[17]

Without a good sense of the back story of both energy and finance systems, then, activists are likely to find it hard in the end to make sense of concepts such as "financing energy democracy" or "financing a green energy transition". Just as a homely, oversimplified "front story" notion of energy as something that relieves poverty, keeps grannies warm and lights up rural schoolrooms cannot help activists grasp the challenges presented by an energy system that is, in fact, organized around the unrelenting extraction of huge surpluses from workers, farmers and the earth, so, too, the equally quaint "front story" idea of finance as a pot of money passively waiting to be spent on wind turbines, solar panels and picohydro installations is of little use in anticipating the trajectory of ravenous financial institutions whose very existence is inseparable from continued exploitation of coal, oil and gas and, increasingly, on the commodification of uncertainty.

Uncomfortable Truths

Many environmentalists, particularly in the global North, become impatient or uneasy when confronted with such tough political thinking. Surely, they insist, it would be easier just to sidestep all this messy business of power politics, livelihoods, exploitation, movement-building and so on. Wouldn't it save time just to concentrate directly on mobilizing the "trillions" that experts say are needed to keep the business sector growing and global warming at bay, and hope that, along the way, a bit more electricity might trickle through to the 1.3 billion people without access to it?[18] Anyway, don't we realize that the urgency of the climate crisis simply leaves no time for popular movements aimed at structural change and the serious analysis of the financial and energy systems that they require? Surely, the argument goes, for NGOs to offer a fast, acceptable, comprehensive "alternative energy plan" to business and bankers will bring quicker results than joining in an uncertain, drawn-out, open-ended process of democratic mobilization, experimentation and exploration that forges alliances and "thinking partnerships" with precisely those forces that are challenging the political status quo.

Thus some activists argue that it is the failure of NGOs to come up with tangible alternatives acceptable to international financial institutions, governments, and private investors and financiers that lies behind the failure to stop mega-infrastructure projects – and that the only way forward, given the limited time scale available, is to work with institutions like the World Bank to channel their billions of dollars in the right direction.[19]

Time "may not be on our side," agree two university professors writing on "carbon capitalism", if "we" do not accommodate ourselves to dominant financial institutions.[20] Change "which comes from below and through resistance," they believe (ignoring most of the lessons of history), "leaves untouched" the world's "powerful interests"; for them, there is no way of influencing institutions without pledging allegiance to them. What particularly worries such observers is their seeming conviction that to contest, as a part of day-to-day activism, the current hegemony of finance and business on virtually any environmental issue would be equivalent to claiming that the world has to wait "until capitalism is ended before we halt the ecological crisis, or at least substantially slow it down".[21] From this perspective, most

grassroots activists working in defence of commons; campaigners for "nonreformist reforms" that seek to open up new political space at the same time they alter the actions of dominant political institutions;[22] and advocates of a "prefigurative politics" in which a "new political present" is constructed "within and alongside the old" – including the collective, anti-vanguard Zapatista strategy of refusing to "take power" and instead "creating in the present the world they want to see in their own autonomous municipalities"[23] – are engaged in a composite struggle that, at best, would just take too long. Now is not the time, the argument goes, to probe how finance really works, what the role of energy is in capital accumulation, or who is to own and control the energy transition – and certainly not to apply the lessons to everyday activism.

Not that such environmentalists are prepared to give in to every demand that business and finance make – far from it. Rather, they hope to take capital up on its motto of constant transformation and persuade it that certain changes it might otherwise be reluctant to undertake are in fact in its own interest or at any rate cannot be avoided. Thus the abuses, dislocations and pollution associated with fossil fuel extraction must be halted: so let's campaign to stop destructive projects and insist on standards, safeguards and the free prior informed consent of affected communities. Fossil energy has no future: so let's promote renewables. Historically, the World Bank and many private banks have both bankrolled fossil fuel developments and exacerbated poverty: so let's get them out of coal and oil and make sure they don't take a controlling hand in any subsequent "climate investments" either.

So far so good. But at a certain point, the tough political and environmental questions recur. What happens when large companies use their wealth and leverage to isolate communities, buy their consent, and prevent the enforcement of standards? Through what kind of alliances could *all* destructive extraction of fossil fuels be halted, save those based on an entirely different conception of energy? As for renewables, under what circumstances might they actually be effective in displacing fossil fuels, and under what circumstances do they merely supplement them, making global warming worse? And even if they did replace fossil fuels, wouldn't a system of renewable energy formed on a fossil model be as destructive of the land and those who depend on it as the current regime – as is currently happening with agrofuels?

Moreover, if we want to source the finance we believe we need for our proposed "power shift" from institutions other than the World Bank and the like, where are we going to find it in a financial system committed virtually across the board to the fantastic levels of productivity provided by fossil fuels and the even more otherworldly rates of return that 30 neoliberal years of unrelenting financial alchemy have taught investors to crave? Is a post-fossil civilization really going to be erected on trillions of dollars cycled through Wall Street? And if other financial institutions such as the Green Climate Fund are supposed to escape from the imperatives driving the rest of the business system, how would that work exactly? How can popular movements best control the damage that such institutions do, and, more importantly, open up political space of other kinds? Many social reformers, it seems, are continuing to demand trillions of dollars from a financial sector that no one understands in order to conjure up something whose purpose few can define.

Many would-be energy reformers, particularly in the North, are tempted to try again to evade such difficult issues. At this point they often go abstract and homiletic, asserting, as a matter of faith, that, whatever experience might teach, there "ought" to be ways of getting "good" energy from "best practice" finance without much risk of the good being swamped by the bad. Once again, however, the evasion doesn't succeed very well: such optimism usually turns out to be based on highly unrealistic assumptions about energy, finance and politics alike.

For example, activists who fancy that they might be able to lure the financial sector away from destructive energy simply by offering it advice about how to channel its trillions into "less damaging sectors", cannot explain why the offer of such free advice should succeed now when it has failed in the past – that is, why following that advice should be in the financial sector's interest, and if it is not, what sort of political organizing would be necessary to ensure it would be followed regardless. Also left unmentioned is whether there are any "alternative" sectors or movements in defence of subsistence that would *not* be damaged by such trillions.

One NGO based in Germany imagines that the impoverishing, restricting and climatically-disastrous structure of energy finance can be swept away by presenting the existing financial sector with a complicated list of philosophical precepts for it to obey, derived from the "existing core principles and tools of international environmental law and human rights", with their concepts of "justice and fairness".[24] It is not explained how these lofty "ethical principles" are to gain leverage in the world of *Realpolitik* against the corporate sector's constitutive need for a type of energy uniquely adapted to facilitate exploitation of labour, rapid turnover and financial speculation. Nor is it explained how financial institutions might be prevented from using their participation in such discussions about abstract "principles" as a welcome cover to strengthen their capacity to pursue *un*principled practices. Indeed, it is assumed that such explanations are unnecessary: if things go wrong, it is implied, that could not possibly be the fault of those proposing the "ethical principles" and "standards" – who are just trying to make things a little better and "control the damage" – but only the fault of those who decline to implement them.

Unwitting Damage

More than a century ago, the British writer G. K. Chesterton took note of the unwitting damage to people's lives that this sort of activist innocence can do in his critique of what he called "idealists" or, alternatively, "autocrats":

> ". . . who give us generally to understand that every modern reform will 'work' all right, because they will be there to see. Where they will be, and for how long, they do not explain very clearly. I do not mind their looking forward to numberless lives in succession; for that is the shadow of a human or a divine hope. But even a theosophist does not expect to be a vast number of people at once. And these people most certainly propose to be responsible for a whole movement after it has left their hands. Each man promises

> to be about a thousand policemen. If you ask them how this or that will work, they will answer, 'Oh, I would certainly insist on this'; or 'I would never go so far as that'; as if they could return to this earth and do what no ghost has ever done quite successfully – force men to forsake their sins. Of these it is enough to say that they do not understand the nature of a law any more than the nature of a dog. If you let loose a law, it will do as a dog does. It will obey its own nature, not yours. Such sense as you have put into the law (or the dog) will be fulfilled. But you will not be able to fulfill a fragment of anything you have forgotten to put into it."[25]

Chesterton carefully does not say that no lobbyist's efforts at "damage control" or reformist's "campaigns for ethics" will ever work. He merely questions the notion, already widespread in his day, that for every issue and circumstance there will always be a constructive role for "ethical", legal or technocratic kibitzers who imagine they can do good while remaining aloof from politics and movements for structural change.

Somewhat more realistic are NGOs which argue that the financial sector must learn to turn away from fossil investments and regard them as "stranded assets". Most of the remaining coal, oil and gas remaining in the ground, they insist, is "unburnable" due to the threat of climate change, and investing in its exhumation would only inflate a "carbon bubble" that would soon burst.[26] Yet a popular alliance strong enough to enforce this claim of abstract "unburnability" against the accumulation imperative driving the corporate sector as a whole has yet to emerge, and most prophets of a "carbon bubble" have no movement-building programme that could ensure that it bursts. As of 2014, corporate and state planners as a whole are bent on burning every last bit of the earth's supposedly "unburnable" carbon, and they are not going to be turned aside by scientific or economic argumentation alone.

Still other groups of activists, more closely attuned to the intimate links among fossil fuels, capital accumulation and modern finance, gesture in the direction of an "energy commons" or "finance commons" as a way of undermining the entire complex, pointing to a continuing historical pattern of resistance to coal- and oil-based economic growth that is often associated with traditions and experiments in non-fossil livelihoods. Yet divergent analyses and backgrounds, lack of awareness of commonalities, and limited opportunities for coordination and mutual learning have slowed the emergence of the needed movements.

Any attempt to find a "short cut" around the hard graft of popular movement-building in order to come to terms with the "urgency" of climate change and energy poverty, in other words, not only doesn't work. In the end, it takes up even more time in dead ends and backtracks than the movement-building "long way around" whose prospect is so unsettling to many Northern activists. Tough political analysis and difficult political organizing, it turns out, are not a "luxury for those who have the time" but a necessity whether you think you have the time or not.

This needs no spelling out for most grassroots activists in the South. They are wearily familiar with the damage done by well-intentioned "apolitical" projects or "damage control" schemes run by technocrats or consultants who imagine that they can avoid getting to grips with

power relations, and who as a result end up making interventions on the side of the rich and powerful. Banks and other businesses, too, have always understood perfectly that ethics, regulation and the law itself are, among other things, raw material out of which, over time, future profits – and future crises – may be crafted, merely through arbitrage, say, or by changing the original background conditions under which the relevant principles were originally formulated and interpreted.

It tends to be only the people in the middle – distant from both the grassroots and the boardroom – who are tempted by the mirage of "nonpolitical" shortcuts as a response to urgent problems. That is why they are the most tempting targets for corporate invitations to participate in "damage control" exercises or programmes for action that promise multiple "wins" for rich and poor alike. As has been documented over many years, firms such as oil giant BP and public relations firm Mongoven, Biscoe & Duchin regard NGOs of the large, well-funded variety who fancy themselves as pragmatic "dealmakers" unencumbered by agendas for long-term structural change as patsies that are easy to "neutralize".[27]

Ironically, then, it is those who are closest to the detailed workings of power, whether at the grassroots or in the boardroom, who are least likely to regard as "academic" the question of how an energy transition might fit into a wider, long-term political agenda. For them, the plea of some energy campaigners and scientists that climate change or energy poverty are "too urgent" for them to have to spend time working on structural change – indeed, to spend time on anything other than lobbying a few "authorities" to get "trillions" shipped to the right places – is simply naïve. While corporations, financial institutions, and the politicians and bureaucrats who work with them happily exploit this naivety, grassroots activists seeking allies among the Northern middle classes are continually frustrated by it.

Apocalypse Thinking

Many of the standard tactics of conventional campaigning – whether preaching "ethics", "science", "human survival" and "economic crisis" to finance and business, or urging a more stringent "anti-imperialism" on Southern elites represented at the UN – seem currently to be having no more overall effect on the direction of global energy policy than, to cite a popular Thai saying, playing the violin has on a water buffalo.

Yet when seized by a certain apocalyptic mood, many activists, convinced there is no time to evaluate the lessons of the past or present, and unable to think of anything else to do, wind up repeating tactics that they know will be powerless or worse in responding to the current predicament. Like rabbits caught in the headlights of a speeding car, they are so gripped by the urgency to do something – anything – that they are tempted simply to run straight into the oncoming vehicle.

But perhaps there is another way. Perhaps concerned world rabbits have a moment or two, after all, in which they can turn their attention to craftier strategies. Perhaps there are ways of respecting the seriousness of the contemporary predicament while resisting the apocalypticism which, as analysts such as George Caffentzis and Erik Swyngedouw point out, has always been a trick capital uses in times of crisis to terrorize ordinary people into putting their brains on ice while business regroups and locates new subsidies.

As Slovenian philosopher Slavoj Zizek urges, it may be precisely times like the present when "slow, careful thinking", rather then desperate, hasty measures, is most needed. If the water buffalo of the world's financial establishment is not listening appreciatively to the music of activist violins, perhaps the response should be not to play louder, but to take an intermission to reanalyze strategies.

One place to start might be simply to ask what music finance is responding to, and why it is so irresistible. Rather than flinging the customary impreciations at "barriers to change" such as stupidity, greed, denial, cowardice and so forth, it might be more constructive to try to find out out exactly what the historically-embedded dynamics are that tie modern investment so stubbornly to coal, oil and gas and the mechanisms of inequality that accompany their exploitation.

Sources:

George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013, pp.11-57;

Erik Swyngedouw, "Apocalypse Forever? Post-Political Populism and the Spectre of Climate Change", *Theory, Culture and Society,* Vol. 27, No. 2-3, 2010, pp.213-232;

Slavoj Zizek, "Thinking the Occupation", http://www.egs.edu/faculty/slavoj-zizek/videos/thinking-the-occupation.

"Urgency" in the Service of Delay

The case of carbon trading – a purportedly "nonpolitical" approach to global warming and energy technology – is illustrative. Throughout its history, the argument for carbon trading has been that, as an initiative that "depends on prices more than politics", it should appeal to business, the state and environmentalists alike – indeed, anyone looking for the fastest, easiest, most efficient and cost-saving solution possible. Carbon trading was supposed to obviate the need for structural political change by building incentives to tackle climate change into existing markets. Businesses faced with steeply rising costs of using fossil fuels were supposed to taper off, opening a rich new market for low-carbon technological innovation that other firms would rush to take advantage of. Private investment would be automatically redirected toward non-fossil energy sources, with impressive results beyond the dreams of any 20th-century socialist planner.

Unlike traditional regulation, taxes, or state-supported infrastructure revamps, carbon trading was supposed to be a solution that could be undertaken immediately and relatively painlessly, with minimal time wasted in building political alliances. Even a few leftists who remained committed to a socialist future were for it, having persuaded themselves that carbon trading had the capacity to "address climate change now, even while global capitalism persists,"[28] whereas movements aimed at building new commons, undercutting wage slavery or contesting the accumulation imperative were just too long-term to stake human survival on.

It turned out, however, that making carbon trading "work" required not only discarding a great deal of fundamental science,[29] but also undertaking a vast and lengthy programme of nothing other than … precisely the kind of painstaking political mobilization that the scheme was supposed to make unnecessary. For example, carbon markets could work only if carbon was made scarce by state-imposed emissions caps,

driving the carbon price up to meaningful levels. But to get states to mandate anything other than token caps would have required a project to organize powerful political blocs that carbon market proponents were unwilling or unable to undertake.[30] After all, as anyone who grasped the "back story" of Big-E Energy (sketched above on p.7 and in "Energy as Struggle", below) understood, the entire contemporary system of making profits out of labour depended absolutely on cheap fossil carbon, and no business sector could possibly give that up merely because of the threat of global warming, particularly when the political means were easily available to ensure that any caps set were ineffective.

Activists who were innocent of this back story were easily lulled into the delusion that an impersonal, smoothly whirring, clicking carbon market "mechanism" would make a more broadly politicized climate movement – with links to progressive labour, family farming campaigns, and agitations for commons of all kinds – unnecessary. Sincerely convinced that carbon trading could address climate change in the absence of a much larger political agenda, they couldn't understand why governments and the United Nations were so reluctant to heed scientific advice and engineer a high carbon price, attributing the failure of the system to irrationality or "denial" rather than their own fundamental misunderstanding of energy and a lack of grassroots organizing.

Meanwhile, business, which understood the back story of energy a great deal better, shrewdly turned its attention toward a different form of political mobilization: one which would ensure that carbon trading became a delaying tactic to keep the fossil carbon flowing rather than a means of cutting it off. They were joined by NGOs who, perhaps all along, had themselves viewed carbon trading as a way of organizing political acquiescence in continued fossil fuel extraction. Hence the political organizing that did take place around carbon trading was not directed at making it work for climate goals, but at precisely the opposite objective. Lavish sums were doled out to incentivize consultants to come up with ingenious means of manufacturing vast numbers of saleable pollution licences out of the most unpromising materials – for example, by allowing refrigerant corporations in China to sell rights to emit millions of tonnes of carbon dioxide to Europe merely by promising not to release as many chloroflourocarbon molecules as they claimed to be "planning" to do. Technocrats kept climate debates focused on carbon price levels rather than the irrelevance of price to structural change. Corporations in the oil and gas, cement, chemicals, steel, aviation and paper industries, meanwhile, banded together to threaten governments with dire consequences if they tightened emissions caps. Measurement and legal scams of all types were organized and bankrolled.

As a consequence, carbon trading has not only achieved no climatic results, but has actually set back the cause of slowing global warming. What was supposed to be a quick "short cut" to climate results that sidestepped the time-consuming tasks of understanding and mobilizing around the politics of energy has now monopolized well over two decades of global warming politics with less than zero environmental result. The Russian Revolution, the dismantling of the Berlin Wall, and a number of other events in recent political history that, by contrast, have had far-reaching results, were organized in a fraction of the time.

The Plan of this Report

The premises underlying many current campaigns seeking finance for a livable energy future, this report suggests, need to be reconsidered. It may be time to revisit questions as basic as "What is energy?", "What is finance?" and "How does real change come about?".

Far from being too time-consuming, such re-examinations may well prevent a great deal of time being wasted both in attempts to square various political circles and in frustrating efforts to reinvent movements that in fact already exist. This report argues that effective movements seeking finance for a greener and more democratic energy future will look at energy and finance not as "things", but as political processes in motion. How can the strongest alliances for the needed changes be made? Where are the destructive, currently-dominant energy and finance regimes most vulnerable? Both inquiries can be helped by an understanding of how energy and finance have been constructed and contested over two centuries of stormy transformations in industry, livelihood and exploitation.

The remainder of the report is divided into four sections: "Energy as Struggle", "The Energy of Finance and the Finance of Energy", "China as New Chimney of the World" and "Whose Side are You on?"

The second section, "Energy as Struggle", invites readers to look at energy not as a neutral background to history – an unchanging something that humans always need more of – but rather as a relatively recent invention shaped by an ongoing power struggle waged by industrial elites to accumulate as much as possible from the work of ordinary people. "Energy", the section argues, is what cultural critic Raymond Williams called a "keyword" – a slippery abstraction that trains people into holding certain political biases without their being aware of it. The bias of "energy" is that it posits an eternal scarcity of a kind that can be relieved only by industrial production, the destruction of commons and subsistence, and the rule of experts.

Repoliticizing energy means revisiting the scientific discipline that, more than anything else, gave it its cachet of neutrality: 19th-century thermodynamics. Thermodynamics, this section shows, occupied itself above all with formulating models for commodifying, controlling and intensifying industrial labour and maximizing its benefits for factory owners following the first age of enclosure or land privatization in Europe. Energy itself was defined as the capacity of a physical system to do work. The First Law of Thermodynamics helped untangle heat and mechanical, electromagnetic and chemical energy from their previous social and natural contexts, showing how they could be combined and exchanged with each other to form a single, liquid, commodifiable whole that could be indefinitely aggregated and subdivided. In so doing, it helped open business's eyes to the possibility of flexible production that did not need to assume, in the words of one historian, a "fixed limit on the forms of energy that could generate work". Not only the body, but all of nature itself, became a "machine capable of producing mechanical work" or "labour power".[31]

This vision grew out of, and was embodied in, the entrenchment of fossil fuel-based steam engines converting heat into mechanical energy, electric motors converting electricity into motion, dynamos converting mechanical energy into electricity, reactors converting nuclear energy into heat and then electricity, and so on. Each such technology contributed in different ways to business's project of mobilizing and disciplining labour and making it more abstract, calculable, manipulable and productive of surplus. The steam-coal combination enabled capital to concentrate labour at any urban location it chose, disentangle it from place and the cyclical time of days and seasons, make good on its perennial threat to discard and impoverish workers who did not come up to proper standards of obedience, and micromanage it at minimal cost according to the rhythm of the machine. Electricity, by coupling the motor more directly to the tool, made labour-power even more susceptible to detailed control, while automatic machinery rendered it still more deskilled, fragmented and abstract. The Second Law of Thermodynamics, meanwhile, helped focus industry's awareness of the dependence of growth on both efficiency and endless cheap imports of high-quality energy to replace the energy whose capacity to do work was lost in production.

Constructing the new scientific "energy" involved the work not only of engineers, businesses and thermodynamic theorists, but also economists, machines, colonial administrators, slave traders and bureaucrats, as well as the labour of plants and marine life over the millions of years it took to create fossil fuels. Only through the gigantic, flexible, cheaply transportable concentrations of power in coal, oil and gas could different kinds of energy have been commensurated and commodified on a world scale, a dedicated "energy sector" developed, or the wage-labour relation generalized through society to such an enormous extent. Without steam engines, conversely, neither coal nor iron mining could have grown so fast. Without colonial plantations, much of the new machine capacity would have been meaningless. The dominance of the new energy that thermodynamics defined came about only through a new regime in which political, technical, financial and fossil elements were fused inextricably in novel ways of mobilizing and appropriating surpluses.

The physical separation of energy sources from engines and other energy converters, and the rise of dedicated energy networks (coal transported by sailing ship and by railroad, oil pipelines and tankers, electricity grids) went hand in hand not only with more flexible production and the generalization of wage labour, but also with the generalization of consumption. Electricity networks made possible a world of consumer durables, and oil pipelines a world of automobiles, suburbs and plastics. The "cyborg labourer" – a fusion of human and machine maximizing productivity – was joined by the "cyborg consumer" locked into high-energy consumption guaranteeing markets for that productivity, as well as by "cyborg land", which blended soil, machinery, oil, ores and crops to produce feedstocks for both industry and labour.

In virtually every respect, the rise and persistence of thermodynamic energy – what was referred to in our first two reports as Big-E Energy – can be seen as a continuing, constantly-evolving struggle against commons worldwide. For example, thermodynamic or Big-E Energy helped to enclose or privatize the commons of human livelihood activity, as reflected in the way the notion of wage labour came to dominate the meaning of words for "work" in European and other language families. Big-E Energy

also necessitated the enclosure of fossil fuel extraction locations, transport networks and processing sites – an enclosure that is now becoming even more extensive as land-hungry "substitutes" for fossil fuels such as wind, solar and biofuels are increasingly sought. Such processes of enclosure are powered by the continuing environmentally-destructive cycle of unequal exchange described by anthropologist Alf Hornborg, in which cheap, high-quality Big-E Energy capable of yielding large quantities of thermodynamic work is shipped from extraction zones to production sites, where it is degraded to produce more expensive goods that can then be exchanged for even greater quantities of high-quality Big-E Energy.[32] At the same time that the holes go deeper in one place, the towers in another rise ever higher. As energy mining and energy consumption climbs, added social critic Ivan Illich, ordinary people's opportunities for provisioning for themselves, getting about independently, or learning autonomously, are closed out in both extraction and production zones.[33]

The report's third section, "The Energy of Finance and the Finance of Energy", stresses that finance, like energy, is not a "thing" (like a pot of money) but rather a political process, a trajectory, a continuing social struggle. In considering the evolution of institutions such as the joint stock company, state and corporate financial institutions, including investment banks, the section also traces some crucial links between finance and thermodynamic or Big-E Energy and how the institutional forms that have emerged to pool and direct capital have also transformed capital itself, making it more mobile and intensifying its exploitative pressures on workers and the environment.

The connections between finance and thermodynamic or Big-E Energy have been intimate from the time of the first emergence of energy supply networks and a distinguishable "energy sector". Today, nine of the 12 most heavily capitalized corporations in the world are energy companies. Project finance, until recently the principal means of financing oil and gas and power projects, was born in the 1930s when a Dallas bank extended a nonrecourse loan to an oil and gas company seeking an off-balance-sheet form of finance that would enable it to develop new fields without placing its core assets at risk. Finance has also always been crucial for ensuring that enough profits from the exploitation of labour flow to producers of fossil fuels to keep the system going.

Early railway expansion in the US and elsewhere, moreover, was possible only through sophisticated syndicated financing. As electricity pioneer Thomas Edison noted early on, meanwhile, easy financing is as necessary to the commercial success of electricity networks "as a good dynamo". In the US, financial unification made possible the technical unification of regional and national electricity networks. From the outset, General Electric was a financial as well as a technical firm. Utility companies, which began as financial companies acquiring and consolidating existing mini-networks, understood, meanwhile, that the construction of a grid demanded banker-like knowledge of complementarity of demand throughout the system. Huge, centralized generating plants, most particularly nuclear power stations, have equally huge capital needs, requiring massive borrowings on the financial market. For the past half-century, in addition, only the intervention of the World Bank and other international financial institutions have made possible the global South's infrastructure for transferring high-quality Big-E Energy from hinterland to metropolis.

As the generalization of the wage relation through mechanization fuelled by seemingly limitless amounts of Big-E Energy opened up new productivity horizons, financial relations could also be scaled up, entrenching illusions of infinite economic growth and indefinitely-extendable compound interest. As political scientist Elmar Altvater argues, one result was to conjure up a "nirvana of global financial speculation".[34] When the product of labour power shaped by Big-E Energy appears as interest-bearing capital, the stage is set for crises in which not only finance, but all productive sectors, are pushed into exaggerated forms of plunder and cannibalism in order to attain unrealistic rates of profit. Indeed, the relationships among investment in Big-E Energy, financialization and economic crisis are especially worthy of attention at the current moment.

As in past crises, investment in energy has become directed not only at increasing productivity, but also at absorbing overaccumulations of capital. At the same time, financialization has encouraged private sector investors to look for returns of 10 to 15 per cent on large energy infrastructure projects; for Southern countries, the profits demanded are often twice that or more. That severely biases energy investment against the poor, against projects sensitive to local needs, and against a livable future climate. Key decisions relating to infrastructure investment have become the prerogative of a tiny, alpha-hungry elite of a few fund managers from 120 to 150 private institutions based in a few Northern countries.

At a time of declining profit rates in the industrial economy, energy finance increasingly seeks to use infrastructure investment simply to divert public money into private hands. Private-public partnerships are on the rise everywhere, together with new financial products, tax breaks, "pension grabs", government gifts of land, and other mechanisms aimed at guaranteeing private investors' "right to profit" at the same time that austerity measures eat into the livelihood security of the less well-off. Energy companies themselves have sought new subsidies from taxpayers, found new ways of stealing from energy-rich regions, skimped on safety, cut research and development, and plunged more deeply into financial games themselves, ranging from new, derivative-based, project-securitized finance deals to commodity index funds, credit default swaps and plays, and institutions and devices bearing bizarre names like "spark spreads" and "master limited partnerships". Publicly-traded debt, in which the lender has no relationship with the borrower, only with other lenders, has become crucial to the absorption of surplus capital via syndicated lending – a strategy that, by the early 2000s, was supplying one-third of all international loan financing. An oil futures market launched in the wake of the nationalization of oil extraction by exporting countries beginning in the 1970s has helped shift power over energy pricing back from OPEC toward Wall Street and the international oil majors, linking Big-E Energy and financial speculation still more closely.

Structural trends in energy investment in the 2010s, in short, centre on accelerated larceny combined with a growing financialization of energy and energy infrastructure as asset classes.[35] At the same time, due to the continuing centrality of Big-E Energy for labour productivity, investment in the so-called "green economy" is directed mainly at projects that leave fossil fuel use unaffected. According to the US Energy

Information Administration, the proportion of the global consumption of energy generated by coal, oil and gas, a little under 81 per cent in 1980, increased to over 86 per cent by 2006, while World Bank figures show that the ratio of fossil-fuelled to total energy consumption has increased three per cent over the last decade.[36] Small-scale, decommodified energy projects, controlled by and for local people, are extremely unlikely in the current atmosphere of financialization to attract the investment of pension funds and other institutional investors. The most that can be expected is that investors will try to siphon off for their own use benefits from publicly-funded contracts for off-grid village electrification, university and hospital schemes, or companies adopting off-grid technologies for commodity extraction or reduced energy costs. Other topics explored in this third section include the importance of the 1970s oil crisis as a spur to financialization.

Building on some of these themes, a short case study, "China as New Chimney of the World", then explores how massive foreign direct investment in China from the turn of the 21st century has been aimed primarily at bringing together masses of cheap labour with coal-fired electricity in an attempt to reboot capital accumulation. This study, which draws heavily on the work of Swedish sociologist Andreas Malm, forms a transition to the report's final section.

This section, "Whose Side Are You On?", finds that adopting the previous sections' treatment of energy and finance not as "things", but rather as processes or trajectories, has useful implications for the strategy of campaigns for a green, democratic energy future. For example, if a "green" or "democratic" Big-E Energy will always be a contradiction in terms, perhaps for energy activists to try to separate out "good" and "bad" Big-E Energy is an unfruitful, potentially divisive way to start. It may be more constructive to begin from something like the red arrow on page 7 and take a more comprehensive, transformational approach. Viewing the emergence of Big-E Energy as one elite response to the defence of commons (in the manner of the arrow) helps free campaigners from the temptation to assume that today's dominant approaches to energy derive from a misguided or shortsighted intellectual "model". It implies that effective movements will not be organized around trying to persuade political or financial elites to adopt "alternative" intellectual models. Rather, they will join existing oppositional forces in a struggle already being waged – one that ranges over a wide variety of arenas, from science to feminism to labour rights. They will make common cause with the movements in response to which dominant interests in business and the state have always shaped their strategies.

This strategy would build on the insight that there is no "inside" and "outside" to energy institutions and energy politics – no "revolutionary paradigms" pitting themselves against a "mainstream" entirely external to themselves, no separate red arrow outside the one on page 7 pointing in the opposite direction. Rather, there is one connected, evolving process in which bitterly antagonistic social groups are constantly responding and adjusting to their opponents. This vision of energy activism replaces the question of how to recruit allies to help implement abstract, elite-formulated alternative plans with a more down-to-earth question that takes the persistence of social conflict as a given: whose side are you on?

By the same token, showing that scarce, thermodynamic Big-E Energy is not a human universal, but rather the result of an ongoing social process, helps make more visible practices that can, retrospectively and anachronistically, now be described, in opposition, as "little-e energies". In so doing, it suggests that while effective advocates of environmental justice in industrialized societies necessarily must start by working with practices that Big-E Energy currently dominates, they need not postulate the impossible goal of "providing green Big-E Energy for all", but might more fruitfully join with existing social movements to open more space in the long term for the little-e "energies" of the commons. One virtue of this vision is that it encourages promising alliances with a variety of movements that mainstream observers might dismiss as "not being about energy" but which, it turns out, have indeed always been about the struggles in which energy campaigners are also engaged.

Such a vision argues for caution about tacitly orienting energy activism around the assumption that a "good" international Wall Street or City of London might someday be coaxed out of the bad old one. The structure of contemporary finance, like that of contemporary energy, demands to be re-studied, and radically oppositional pathways recognized, rediscovered, respected, supported and developed. Before activists get too caught up in excited or "urgent" plans for tapping the financial sector's "trillions" to develop "green and just energy", they might ask what these trillions actually consist of and what is likely to happen if they are single-mindedly deployed on Big-E Energy.

Energy as Struggle

"Energy" as Keyword

Energy is often thought of as a physical entity that, in itself, has no politics. When we talk about kilowatts and fuel efficiency, it is said, you are talking about science, not expressing an ideology. You are stating facts, not conveying an outlook. You are describing a given reality shared by all, not taking sides in a social struggle. You are describing the eternal background to history, not using a concept that is itself a historical product. Energy might *have* a politics, the story goes – as in the phrase "the politics of energy" – but it *itself* is not political.

"Energy", in short, is among those ubiquitous contemporary "keywords" that, as the British cultural critic Raymond Williams once put it, seem to be "mere transparencies, their correct use a matter only of education".[37] Like many other modern abstractions such as "resource", "nature", "development", "economy", "services", "work" and "education", they seem neutral (*see* Box: "Keywords"). As long as policymakers and activists remember their high-school physics classes, it is assumed, any disagreements they might have about what energy is all about will be trivial, temporary or residual.

Thus most discussions of energy policy – such as how to finance a transition to a democratic, climate-friendly energy regime – seem impatient to put the definition of energy behind them as quickly as possible in order to pass on to the "real issues": how energy can be best produced, distributed, financed, conserved; what kinds of energy are better, what kinds are worse. Energy is simply the "basis of everything", writes energy expert Richard Heinberg in a book on the future of industrial society, from plant growth, car travel and home heating to the maintenance of "ecosystems and human economies".[38] "Since humans were humans, we've used energy", declares a recent graphic novel detailing possible low-carbon futures, swiftly moving on to describe how successive energy technologies impelled by "leaps of imagination" on the part of disinterested researchers have broken through barriers that kept "ancient empires" hobbled by slavery, slow communication and "inefficient" agriculture.[39] Energy has always been there, the assumption goes. It's just that – thank goodness – we have a bit more of it now.

A more nuanced view would take seriously Raymond Williams's caution that issues such as energy finance cannot be thought through, or even brought into clear focus, unless "we are conscious of" the slipperiness of words like "energy" as "elements of the problems".[40] Sensitive to anachronism, such a view would recognize that the concept of energy – and other practices associated with it – are political organizing tools with a bloody genealogy that cannot be erased. These practices have no more "always been there" than the practices associated with other keywords such as "the economy" or "nature". Energy is something people continue to struggle "against" as well as "over". While embedded in the everyday lives of billions of people and now taken for granted by actors across

the political spectrum, it is associated with a particular set of historical interests and contains inside itself a particular ideological bias.

This ideology is one that movements for a democratic and green energy future need to reveal, not conceal. Effective action as well as clear analysis requires that the concept of energy itself be repoliticized and rehistoricized.

Keywords

Returning to his native Britain to finish his university degree after military service in the Second World War, a young soldier named Raymond Williams, who later became a celebrated cultural critic, found that people had begun to use words such as *culture, class*, *democracy* and *industry* in a way he could not recognize. Yet few seemed to be aware that anything had changed, assuming that the words had always been used in the same ways.

Williams turned his bewilderment into 40 years of study of what fellow cultural critic Ivan Illich called the "inconstancy" of certain ubiquitous abstractions "on which his own integrity had rested". Williams called these slippery terms "keywords". More examples include *economy, rights, production, progress, family, race, individual, human, equality, violence, welfare, health, ecology, work* and *sex*.

To a greater extent than ordinary vocabulary designating physical things or narrowly technical processes – like "cellphone" or "sky" – keywords are unavoidable terms "central to common life" that "give a moral and social interpretation to the sentences in which they occur". Collectively, they train the people who use them into a certain "common sense" that seems always to have been there. Illich identified this perspective as one that posits eternal scarcity of a kind that can be relieved only by industrial production, the destruction of commons and subsistence, and the rule of experts.

The keywords *natural resource*, for example, introduce the view that land, trees, water and rock are a tank of raw materials for the use of a "society" that is separated from it and that, if not restrained and "managed", will constantly strive to drain it, in an unending, scarcity-creating process. Along similar lines, keywords such as *transportation, education, development* and *consumption* attribute to human beings of both past and present unbounded needs for quantifiable commodities that can be supplied only through professional mediation or *governance*.

Some keywords are the result of "takeovers" of terms that in previous eras were used for other purposes. The keywords *work* and *job*, for example, have come to mean waged employment, concealing the fact that for centuries of the European past, as well as in most societies today, the terms stood for a much wider field of human activities. Insofar as the two terms conspire to suggest that the only "real" work is something you get paid for, Illich suggested, they put a "pseudo-vernacular gloss on engineered reality".

Similarly, *energy* is today defined as a physical quantity. In Aristotle's hands, however, *energia* was a metaphor for something moving or active. Illich translates it as "on the make", with all of the phrase's sexual connotations. Even when the term *energy* entered English with the Elizabethans in the 16th century, moreover, it was used mainly to refer to, for example, the vigour of an utterance and, later on, the power of an argument or the impact of music. In many indigenous peoples' explanations of relationships among people, animals and the earth, concepts typically translated as *energy* connote spiritual power, force, life, prestige or charisma.

Other keywords are outright neologisms, yet also give the impression of designating a timeless reality. The keyword *resource*, for example, goes back no further than the industrial revolution. Its Thai translation, *sapayakorn*, like *thammachaat* (nature) and other recent Thai concoctions, were cobbled together from much older, only tenuously-related Sanskrit-derived terms. The neologism *phlang ngaan* (energy) is another member of this group of words; its literal meaning "work power" shows the influence of European thermodynamics. Yet all three terms have swiftly become a part of the common sense of the

Thai educated classes and of the *lingua franca* they use to think with and communicate with their counterparts abroad. Keywords, then, colonize the past as well as the future, and the South as well as the North, in a way that conceals the contentiousness of the ideologies they represent. Although *resource management* is a phrase of very recent vintage, dating from the 1960s, it is routinely and unthinkingly used to describe, say, ancient Pacific fisheries or the woodland commons of the European Middle Ages, creating a fictitious continuity between past and present. Similarly, cow dung used for cooking in India becomes *energy.* Photosynthesis becomes an *ecosystem service*. So effective is keywords' attribution of universality to a perspective characteristic only of industrial society that it is only with great effort that today's university graduates can learn to speak of alternatives *to* development rather than "development alternatives", or alternatives *to* energy rather than "energy alternatives". The way keywords conceal conflict and physical violence can often only be seen from outside, by members of the global majority for whom a pasture, or even electricity, is not a "resource", nor cow dung "energy", nor imaginary untouched wildernesses the epitome of "nature".

Sources:

Raymond Williams, *Keywords: A Vocabulary of Culture and Society,* Croom Helm, London, 1976;

Ivan Illich, *Gender,* Pantheon, New York, 1983;

Ivan Illich, "The Social Construction of Energy", *New Geographies* 2, 2009 [1983], pp.11-19;

Jean Robert, "Alternatives and the Technogenic Production of Scarcity", *New Geographies* 2, 2009, pp. 134-38.

Repoliticizing Energy

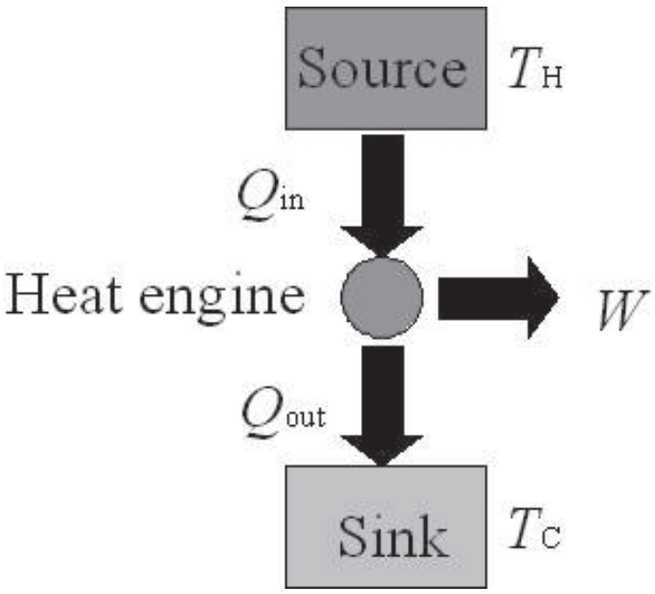
Probably the most important emblem of the mystifications surrounding energy is the idea that energy is a matter of physics and that physics is not political. The strongest way of repoliticizing the concept, accordingly, may be to tackle directly the notion that the science it came from somehow lies outside the history of social struggle. Like all other great advances in knowledge, the science of energy needs to have its inherent political biases appreciated if its achievements are to be properly admired and celebrated.

Although a lot that is relevant to the evolution of "energy" happened before and since, the key period is probably the first half of the 19th century. Before 1800 no one talked or did anything about energy in anything like the modern sense. By 1870 quite a few people did. This change can be represented at least partly by the development of thermodynamics, the archetypal energy physics.

Closely involved were several generations of engineers, chemists, experimenters, doctors, lawyers and other specialists across Northern Europe: Sadi Carnot, Emile Clapeyron, Gaspard-Gustave Coriolis, Jean-Victor Poncelet, Gustave-Adolphe Hirn and Marc Seguin, in France; Julius Robert Mayer, Rudolf Clausius, Hermann von Helmholtz and Carl von Holtzmann, in Germany; Ludwig Colding in Denmark; and, in Britain, Mary Somerville, James Joule, William Grove, Michael Faraday, Macquorn Rankine, James Maxwell, Willard Gibbs, and James Thomson and his brother William Thomson (Lord Kelvin), who belatedly coined the term "thermodynamics" in 1854. The fact that many of these thermodynamic theorists developed some of their most important key concepts independently hints at how widely the problems they were working on, as well as the channels for addressing them, had already been engraved in the minds of the community of technology-oriented elites to which many of them belonged.[41]

Energy, Engines and Industrial Work

One revealing aspect of the thermodynamic theorists' political bent was the extent to which they organized their new concept of "energy" around the emerging idea of industrial labour, especially how to control it and maximize its benefits for factory owners. What impelled and inspired theorists like Carnot, Clapeyron, Coriolis, Hirn, James Thomson, Poncelet and Gibbs (who were all engineers) was the study of engines – in particular, industrial engines at the dawn of the fossil fuel era: how to make them do work in conjunction with human brains and hands; how to make them do it better. Their predecessors and contemporaries were engine developers; and what got the engine developers going were business possibilities. "An *economic* point of view formed the root of thermodynamics," emphasizes US historian Theodore Porter. "Economic and physical ideas grew up together, sharing a common context".[42] This history is crystallized in today's textbook definition of energy as "the capacity of a physical system to do work".



Thus the theoretical "heat engine" that French engineer Sadi Carnot worked on to understand better how to transform heat into work (in the diagram of Carnot's heat engine at right, if Q is heat and T is temperature, W is work) is basically just an idealized steam engine. For Carnot in 1824, the steam engine was a "universal motor", which could be "substituted for animal power, waterfalls and air currents".[43] Such engines included Thomas Newcomen's clumsy early 18th-century invention, which was used to pump water out of coal and other mines, but also, more significantly, the contraptions devised much later by James Watt, who worked closely with business to develop the much more efficient and versatile condensing and rotary engines that found so many uses in factories and transportation. Watt became such a capitalist icon that he, together with his business partner Matthew Boulton (described by diarist James Boswell as "an iron captain" commanding his factory-hand "troops"),[44] are pictured today on the reverse side of the UK £50 note (together with apt quotations revealing the obsessiveness of both) (*see* below).

For many thermodynamic theorists, in addition, control over labour was not merely an issue implicit in the texts of Carnot or Watt, but was even more up close and personal. James Thomson rubbed shoulders with manufacturers throughout his life and was an apprentice to a Manchester marine engine-building business.[45] James Joule's family owned a brewery in Salford, near the growing industrial city of Manchester, where a steam engine had been installed as early as the 1790s, and Macquorn Rankine was also apprenticed to engineering enterprises.[46]

"I sell here, Sir, what all the world desires to have – POWER." "I can think of nothing else but this machine." Two characteristic statements by steam engine developers Matthew Boulton and James Watt quoted on the reverse side of today's UK fifty-pound note.

The question of labour was also on the minds of those thermodynamic theorists who, instead of occcupying themselves with steam engines, focused on batteries, electric motors, the conversion of electric current into heat and light, and the use of electric current to break chemical bonds. James Joule's early work was aimed at making electric motors perform more "duty", as he called it, and as early as 1839, the *Journal of the Franklin Institute* was stressing the connection between research into electricity and labour issues:

> "If we hire a man by the day we must not allow him to be idle, as in that case *we give our money for nothing*. The current of his life flows on, and he must be fed and clothed or the stream will stop. But give us a machine which is not costly at first, and if it works but one hour in the twenty-four, will itself be a consumer *in that proportion only*; a machine which we can *at any moment* set to turn our lathes, our grindstones, our washing machines, our churns, our circular saws".[47]

In that respect, "electro-magnetic propelling machinery" had an advantage in flexibility over steam engines, which were profitable to operate only at full power – not appropriate for all tasks – and had to be tended constantly by engineers and firemen.

Even in the early 19th century, then, scientists working on electricity, like those working on steam, were knee-deep in topical questions of how best to commodify human activity, enclose and simplify it, and disentangle

it from the "unproductive" matrices in which it was embedded so that it could be brought under centralized ownership, circulated and amassed conveniently for maximum profit. In this, they were playing a part in a much wider, longer struggle. Wage labour, through the enclosure of commons, had earlier detached a potentially quantifiable "labour power" that could be bought and sold separately from the multitude of other, "unproductive" aspects of a human being's existence. The putting-out system then encouraged the development of specialization and minute divisions of labour that made the activity of workers more calculable and controllable.[48] Reductions in wages discouraged day workers who had earned their sufficiency from taking the rest of the week off, making them more easily "switched on" when needed. Employers then turned to workshops where labourers could be more closely supervised *en masse*. Labour power was amplified, disciplined, and further purged of "impurities" by steam power applied to workers assembled in factories, increasing owners' control at the same time that new, "external" complications were introduced such as large-scale coal mining. Electricity promised to take the process one step further still – to distill away certain "unproductive" or "resistant" elements of this labour-power-plus-steam combination itself: steam engines' dependence on maintenance workers, inadaptibility to variegated, delicate tasks, and difficulty in switching on and off quickly. The dream was to make labour-power even more abstract, measurable, quickly applied and susceptible to detailed control – even less bogged down in the messy, complicated, incalculable world of bodily survival and interaction among humans and the earth.

During what Lord Kelvin in 1881 baptized the "epoch of energy", the new science of work haltingly moved away from being so transparently business-focused toward being the preserve of a more aloof "elite scientific practitioner"[49] – somebody more like the white-coated university physicist of today's folklore. Over time, thermodynamics theorists helped make energy seem transhistorical, "devoid of its political, social and cultural content", making it easier to fetishize as a "thing in itself with singular independent causal power".[50] Fast-forward to 2014 and it is easy for physics students to assume that the thermodynamic "work" they study has nothing to do with the sweaty politics of layoffs, strikes and labour unions. After all, the "work" that appears in textbook definitions of "energy" ("the capacity of a physical system to do work") is merely a physical quantity measurable as force times distance travelled, or the ability to lift a certain weight over a certain distance – mere horsepower. What could that have to do with the complexities of what people do in offices, shops and warehouses every day?

But the connections between the two made in the mid-19th century has in fact shaped economics and politics ever since. If the "concept of work had been usefully exported to thermodynamics as exemplified in Sadi Carnot's analysis of the steam engine," attempts soon followed to "re-import the thermodynamic concept of work back into political economy . . . to convert skilled labour into kilogram-metres and then to determine wages on this basis".[51] As intellectuals calculated the energy content of different kinds of coal, they also wondered what type of bread would give the most efficient return in human labour power measured in foot-pounds. Was it was more efficient to use coal fires directly in production, James Thomson asked, or to boil urine for fertilizer to

grow crops to feed human workers?[52] Such inquiries reflected not only manufacturers' desire to be able to calculate and improve productivity, and design factories with maximum of efficiency, but also their hopeful Cartesian fantasy of elevating themselves into an active "mind" exerting decisive control over a passive, dumb "body" of workers and the materials they manipulated. As US historian Anson Rabinbach argues, "the image of labour was radically transformed. It became labour power, a concept emphasizing the expenditure and deployment of energy as opposed to human will, moral purpose or even technical skill".[53] By the same token, thermodynamic conceptions of work provided new tools for dichotomizing human activity between, on the one hand, serious, measurable, "useful" work involving the transformation of passive material ("nature") by machines and "human motors" that had to be maintained carefully and directed from above, and, on the other, open-ended interaction, negotiation and self-realization among both humans and nonhumans – types of activity that were likely to be thrown into evolving categories of idleness, recreation, waste, mysticism or irrelevance. In all these ways, the thermodynamics-influenced concept of quantifiable "labour power" provided an enduring, idealized image of how the unquantifiable, multifaceted, open-ended human potential to pursue life and livelihood could be enclosed, simplified, quantified, commodified, and put at the service of machinery owners.

Thermodynamics also provided useful management metaphors suitable for an era in which large numbers of workers had been irrevocably separated from the land and the subsistence guarantees of commons. By making them dependent on machine-owners, this separation had long since begun to release workers' latent productive "energies" for industrial use – but only at the cost of raising risks of uncontainable social "explosions". No one understood this better than Europe's political elites, who for centuries had been fearfully criminalizing roving layabouts, vagrants and rebels who could not be tied down to a particular place. (A similar tension looms large in the imaginations of today's development experts and "free trade" advocates, who alternate between celebrating dispossession in the global South as a means for amassing "human capital" in productive enterprises and fretting about the revolutionary threats posed by the "loose molecules" released in the process.)[54]

To help formulate a response to such threats, models of the universe that went beyond those of Isaac Newton were useful. Earlier on, Newton had helped an emerging business class conceptualize their struggle against such nuisances as "Saint Monday" (*Saint Lundi*, *blaue Montag*) – commoners' reluctance to come to work at the beginning of the week, an aspect of their indifference to the industrial work schedule[55] – by postulating a non-terrestrial, non-circular, non-seasonal, non-diurnal, orderly, mechanical work-time. Such a centralized, universal time, and the God or state that governed it, helped to counter workers' "inertia" and keep them in their proper orbits. By 1800, business, with the help of clocks, wage reductions and machines like Richard Arkwright's water frame (a water-powered machine for mass-producing cotton yarn), had made real headway with the project of keeping labourers at work in workhouses and factories. Removing remaining fallbacks in the commons had also helped, since it forced labourers to choose between working and not working rather than having the option of working only when they needed a bit of money to make up their subsistence.[56] To some

degree, success had been achieved in getting labourers to "renounce their desultory habits of work, and to identify themselves with the unvarying regularity of the complex automation".[57]

Now, however, especially after the 19th-century British Factory Acts began to limit the length of the working day, the challenge was shifting from creating a proletariat from scratch to intensifying its work once it had been established, while preventing it, in the words of energy scholar and activist George Caffentzis, from "blowing out the sides of the container".[58] Here thermodynamic images suggested a way out. Philosopher Amy Wendling describes one of these images when she remarks that:

> ". . . the problem that plagued the engineers of the era who were constructing steam engines was how to regulate these engines for maximal productivity with minimal loss of heat, but some heat loss was necessary so that the engines would not explode or self-destruct".[59]

What is Accountability?

Environmentalists are accustomed to demanding that developers and financiers of solar energy, biofuel or mini-hydro projects be made "accountable" to affected local people.

They are less accustomed to demanding accountability from the scientists and technologists who develop the concepts and research programmes fundamental to such initiatives.

One reason why the energy science developed during the 19th century had such an anti-commons cast – and why current energy politics is leading to such unjust outcomes – is that the leading thermodynamic theorists had no obligations to, and little familiarity with, peasants, cottage workers or workshop hands. They hobnobbed not with factory labourers but with those seeking to control and make maximum profits out of them. The questions they asked and answered about heat, metals and conductivity were shaped overwhelmingly by the concerns of the ascendant social classes they belonged to or aspired to become members of.

Nor has this form of expert bias in energy research ever gone away. As historian David Noble recounts, there is no evidence that researchers developing automated machine tools at the Massachusetts Institute of Technology in the mid-20th century ever met any of the thousands of machinists who were "most directly affected by the technical changes under development". Instead, they were guided by their constant interaction with industrial managers.

Similarly, few of today's alternative-energy experts – who tend to fall in unquestioningly with the planning agenda of industry and finance – have much contact with or loyalty to social movements who might have a more nuanced and effective long-term strategy for a transition away from fossil fuel dependence.

The result in both cases has been a closing out of many pathways toward an equitable future.

There has never been any whiff of conspiracy about this. It cannot be countered in the simple ways a conspiracy might be countered, but only by the far more difficult and complex work of extending a politics of accountability and democratic discussion "all the way down" into physics and into the theory and practice of finance and technology.

Source:

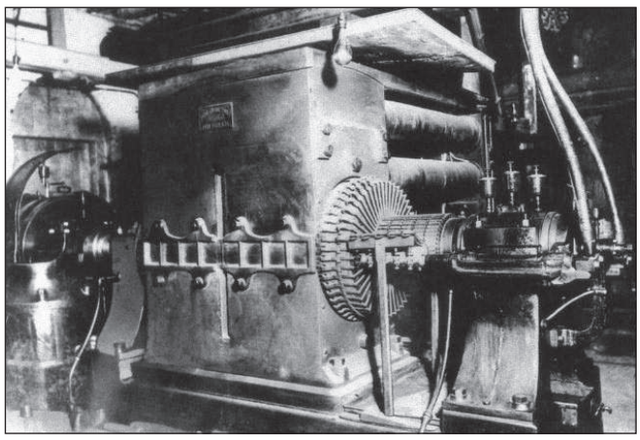
David F. Noble, *Progress without People: New Technology, Unemployment, and the Message of Resistance*, Between the Lines, Toronto, p.74.

Commensuration in Machines and in Thermodynamics

The new, capital accumuation-oriented vision of energy can be summed up in two of the big achievements of 19th-century physics: the First and Second Laws of Thermodynamics.

The First Law, which emerged between 1837-47, postulated a single abstract "force" that "could appear in electrical, thermal, dynamical, and many other forms, but which never, in all its transformations, can be created or destroyed". From any one form, German chemist K. F. Mohr insisted as early as 1839, "all the others can be called forth".[60] After Julius Robert von Mayer in Germany and James Joule in Britain calculated the "mechanical equivalent of heat" in the 1840s, the kilogram-metre, a concept used by French railway engineers, was pressed into service as a common unit among various forces, which could now, figuratively speaking, be put in a single pile and accumulated indefinitely, like abstract labour or money.[61] In effect, the First Law helped untangle heat and mechanical, electromagnetic and chemical energy from their previous social and natural contexts, showing how they could be combined and exchanged with each other to form a single, liquid, commodifiable whole that could be circulated, aggregated and subdivided. In so doing, it helped open business's eyes to the possibility of a flexible production that did not need to assume, in the words of one historian, a "fixed limit on the forms of energy that could generate work". Not only the human body, but all of nature itself, became a "machine capable of producing mechanical work" or "labour power".[62] Work, it now seemed, might be wrought from anything.

The commensurability that thermodynamics postulated between different forms of what now began to be called "energy" grew partly out of, and was embodied in, the astonishing diversity of machines developed and entrenched in industrial practice during the 19th century. Politically speaking, the different forces were made convertible to each other not so much by theorists scratching equals signs on blackboards as by widespread and various antics involving contraptions of iron, rubber, copper wire, coal, gutta-percha and brick in laboratories and manufacturing sites. Just as devices such as the clock helped convert different kinds of activity into work time, 18th- and 19th-century steam engines converted the latent heat of the coal face into mechanical energy.[63] The electric batteries described by Italian physicist Alessandro Volta in 1800 converted chemical energy into electrical energy, as British scientist Michael Faraday showed in 1834. Dynamos – invented around 1830 but not achieving industrial significance until the 1870s – converted mechanical energy into electricity. Electric motors, also developed in the 1830s and implanted deeply into industrial practice with US physicist Nikola Tesla's alternating current motor of 1894, converted electricity back into mechanical energy. From the mid-19th century onwards, the telegraph made the mutual convertibility of electricity and magnetism manifest worldwide. Internal combustion engines, first conceived before 1800 and marketed starting in the 1860s and 1870s, converted chemical to thermal to mechanical energy. Solar cells, first built in 1839 although still struggling today to become entrenched in industry, converted sunlight to electricity. Nuclear reactors then continued the process beyond thermodynamics in the 20th century by converting nuclear energy into heat and then, via steam, into electricity.



Dynamos such as this one installed at Thomas Edison's 1882 Pearl Street generating station near Wall Street in New York heralded the electric grids later to dominate all industrialized countries.

The conjoined efforts of capitalists, engineers and scientists in stringing together such converters yielded whole series of practical equivalents, for example:

Thermal (heat engines) → mechanical (dynamo) → electric (wires) → magnetic (electric motors) → mechanical (crankshafts and camshafts)

Or even longer series:

Thermonuclear (sun) → electromagnetic (light) → biochemical (photosynthesis) → thermal (pulverized coal) → mechanical (boiler) → electric (turbine) → chemical (battery) → electric (grid) → electromagnetic (computer screen) → mechanical (bicycle messenger)

The activities of engines and their makers – and not, say, the diversity of conventional tools in the hands of indigenous or agrarian communities – constituted the "micro-worlds" that made sense of emerging quantitative concepts and theories of energy. Later these micro-worlds extended their filaments everywhere. The abstract, Big-E Energy that resulted became a worldwide currency and bottled "fact" whose origins became hard to remember. The "infinite multiplicity of energetic forms," George Caffentzis writes, "inspired a tremendous optimism in capital's search for new workforces".[64] At the same time, the cost of each workforce in the new, detachable entity "energy" could now be compared and tabulated in a single "energy rent". Supplementing the commodification of diverse human activities, the emergence of a fully joined-up, thermodynamic, Big-E Energy both enabled, and was enabled by, accelerated capital accumulation. Boosting the surplus-producing capacity of workers immensely, each conversion technology – and its combination into various types of network – contributed to business's project of mobilizing and disciplining labour and making it calculable, cheap and manipulable.

Thus in the 19th century, the steam-coal combination enabled capital to concentrate large quantities of workers at any urban location it chose, disentangle them from place and the cyclical time of days and seasons, make good on its perennial threat to discard and impoverish workers who did not come up to proper standards of obedience, and micromanage them at minimal cost according to the rhythm of the machine (*see* Box:

"Cotton and Steam"). To an unprecedented extent, the machine became, in Karl 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.[65]

In the early 20th century, electricity, by disentangling tools from a centralized power source or camshaft and coupling them directly to individually-controllable motors, made labour-power even more susceptible to detailed management, enabling a still "closer filling-up of the pores of the working day".[66] Between 1899 and 1929, the proportion of electricity in installed mechanical power in US factories jumped from 5 to 80 per cent, as coal fires were moved out of workplaces into centralized locations and electricity moved in instead, allowing assembly-line production to take over.[67] Increasing automation subsequently deskilled and fragmented labour still further.[68]

Nor was the disciplinary role of the new thermodynamic energy confined to machines that directly produced goods. The first use of gas lighting, for example, was not in homes or streets, but in factories,[69] helping to abolish the dominance of seasonal cycles of light and dark over labour productivity. The first commercial electric lighting in the world illuminated Wall Street offices. Even the railways played their part in "sweeping away local times and introducing its own standard time", with clocks synchronized with each other in each village along the line in order to keep schedules in order and reduce fatal accidents. "What the industrial worker learned on the factory floor, [the middle classes] learned on the station platform".[70]

Cotton and Steam

Around the world, campaigns are growing to end fossil fuel use and ensure that most remaining coal, oil and gas stays in the ground. Such campaigns understand well that in order to have any practical effect, they have to understand just how deeply fossil fuel dependence runs. They know that they need to avoid false or simplistic explanations of fossil fuel dominance – such as that it is due to a "conspiracy of oil companies", an "addiction" to oil on the part of consumers, fossil fuels' "efficiency" or "technical superiority" in satisfying pre-existing, eternal human needs, or fossil fuels' ability to break through the "limitations" of a biomass-based energy regime. One clue pointing the way toward better explanations lies in the way that fossil-fuelled production grew out of a pre-existing mechanized factory or workshop system powered by water or by human or animal muscle. The associated division of labour was organized at least in part in order to replace workers' control over when and if they wanted to work and how much to make, as well as many of their integrated skills, with the control and coordinating skill of the owner. In the words of historian Peter Kriedte:

> "[o]nly in centralized installations could the production process be supervised, the traditional irregular work rhythms be combated, and the producer be subjected to a rigorous work discipline. In the case of complete centralization, moreover, the turnover of capital could be increased and the transaction costs lowered."

As with the privatization of commons, the aim of the new, pyramidal hierarchy was not efficiency in itself so much as rent-seeking and capital accumulation. The system was in place in many areas of Italy, Britain, France and the US – and had resulted in increased productivity – long before the advent of coal-fired steam engines. The later use of fossil fuels, in one sense, merely modified and enlarged the power to tame the dangerous or inert body of the commoner, making it into a container of commodified labour power, ruled by the mind of the manager or of

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the worker herself.
In the early 19th century, steam and coal were still pretty much strangers to this system. In particular, they remained unpopular with the crucial textiles sector in the UK, France and the US. Water power was a lot cheaper, less prone to breakdown, and continually being improved on. In principle, water power also had the same potential coal did for relieving manufacturers' dependence on what industrial apologist Andrew Ure called "muscular efforts, which by their nature are inconstant and irregular." In a basic sense, water was just as good as coal at introducing "mechanical guidelines, fingers and arms actuated with regularity and at high speed by an inexhaustible physical force." Even without steam engines, big gains in productivity had been achieved in cotton spinning, cotton ginning and other aspects of textile manufacture.

But when the struggle of British workers to limit the legal working day to 10 hours succeeded, the productivity of dispersed and far-flung water mills in the British countryside suffered. Because streams did not necessarily flow at the same rate 24/7 throughout the year, capitalists were hobbled when they could not call on labour whenever needed. They required a new instrument for squeezing the most out of workers. As Swedish sociologist Andreas Malm recounts, steam engines fired by easily-available and -transportable coal fit the bill, and were called out of the relative 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 easier to procure masses of workers that were, in the words of one apologist for business, "trained to industrious habits".

Fuelled by the "ecological fix" of a seemingly limitless, powerful, transportable fuel, steam machinery helped business not only to concentrate workers, but also to make their employment less secure, driving down wages and expanding opportunities for appropriation. 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 labour.

For the first time, the ability to separate an energy converter and its energy source geographically became a decisive political advantage, catapulting coal into the prominent place it still enjoys in 2014 (*see* "China as New Chimney of the World"). As Malm notes, it is because fossil energy can be mobilized by capital to exploit workers virtually anywhere that it became the "general lever of surplus-value production" in the 19th century: "from the very beginning, there was an intimate relation between the rise of the fossil economy and the quest for cheap and disciplined labour power". In fact, the relation was a triangular one among "capital, labour and a certain segment of extra-human nature, in which the exploitation of labour by capital is impelled by the combustion of this particular accessory."

For activists seeking an energy transition today, this history is a useful reminder that it is not merely the relatively high unit cost of dispersed, localizable renewable energy that results in its being suppressed in favour of fracking, unconventional oil, nuclear energy and big hydropower, but also its limitations when it comes to serving the project of controlling workers. Conversely, however appallingly low the energy returns that unconventional oil or fossil-fuel analogues such as agrofuels yield compared to the energy that goes into their production, they will always have the advantage for business of being comparatively effective weapons against labour.

Sources:

Peter Kriedte, "Between Industrialization and Deindustrialization", *in* P. Kriedte, H. Medick and J. Schlumbohm (eds.), *Industrialization before Industrialization*, Cambridge University Press, Cambridge, 1981, pp.137-8;

John Farey, *A Treatise on the Steam Engine, Historical, Practical, and Descriptive*, Longman, London, 1827;

Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production", *Review of Radical Political Economics*, Vol. 6, No. 2, 1974, pp.60–112, p.60;

Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages*, Zed, London, p.100;

Andreas Malm, "The Origins of Fossil Capital: From Water to Steam in the British Cotton Industry", *Historical Materialism*, Vol. 21, No. 1, 2013, pp.15–68;

Andrew Ure, *Philosophy of Manufactures*, 1834;

Silvia Federici, *Caliban and the Witch: Women, the Body and Primitive Accumulation*, Autonomedia, Brooklyn, 2004, p.150.

The Role of Fossil Fuels in the Emergence of Thermodynamic Energy

> **"A factory machine . . . and other things reckoned as capital . . . are fetishes . . . not in their physical existence or concrete functions *per se* but in their reality as material forms (part-objects) of a distinctive type of social system."[71]**
>
> **William Pietz, 1993**

What really cemented the abstraction that is thermodynamic energy into world politics, however, was the addition of fossil fuels to the mixture of heat engines and commodified labour. All three ingredients were key to an accumulation process of unprecedented scale and promise. The ever-evolving possibilities of converting one form of energy into another elegantly summarized in the First Law of Thermodynamics were essential to transforming the latent heat of fossil fuels into a flexible, universally-applicable Big-E Energy (for some of the differences between Big-E or thermodynamic Energy and the "little-e energies" from which it was assembled, *see* "Energy Abstracted" below.)[72]

Conversely, the sheer volume of latent heat transported from millennia of photosynthesis over vast areas of land and ocean in the geologic past to tiny points on the contemporary map was crucial to assembling this commensurated energy on a world scale. Only with fossil fuels – which today account for 83 per cent of global energy production – were the productivity increases possible that made the machine-labour-fossil fuels combination dominant in society. Economist Paul Bairoch remarks that "before the Industrial Revolution no country or region could be really rich".[73] Only with fossil fuels could engines and factories be released from dependence on far-flung watercourses or large amounts of nearby land growing organic fuels for them. It was not that there had always existed a primordial human need for more and more abstract "energy" that just happened to be filled one day by fossil fuels. Rather, fossil fuels themselves played a crucial part in creating the very concept of scarce Energy that we use today.

By the same token, it was the fusion of mobile, seemingly infinite Energy with commodified labour power – which even on its own was increasingly conceived as a "magic wand that could summon limitless growth and prosperity from raw nature"[74] – that facilitated the rapid growth of a "technomass" of machines. Conversely, only this mass of steam engines, electric motors and other energy converters could integrate fossil fuels into a new global organization of labour, extending the wage-labour relationship through whole societies and helping to detach, on a worldwide scale, an interchangeable commodity of labour power from a multitude of matrices of livelihood activity.[75] Only in this way did it become possible to make so many millions of individual workers responsible for their own maintenance out of the wages for which they were dependent on employers, "outsourcing" or "externalizing" the costs of reproducing them and depriving them of any right to life independent of purchasing power.

Such complex synergies go a long way toward explaining the entrenchment of thermodynamic or Big-E Energy in Europe during and after the industrial revolution, but not in other contexts also characterized by the widespread development of ingenious energy converters, such as that of medieval China (*see* Box: "Why is Energy not Old?"). They also help explain why fossil fuels have become such an overwhelming, intractable problem today – and why it is so misleading to single out, for example, "greedy oil companies" as the culprit. As a whole, business simply has no choice but to oppose serious efforts to moderate climate change, because there is no cheap or politically-feasible substitute for fossil fuels in the triple combination of fossil fuels-heat engines-commodified labour that underpins current rates of capital accumulation. Contemporary production depends utterly on the commensuration and fusion of biological activity of different ages in unprecedented quantities. To meet even one-third of current energy demand without fossil fuels would require five per cent of the earth's land area, while replacing oil as a transport fuel at current levels of use would mean enlisting half of all the plant metabolism on earth. With coal as a fuel, 1,000 megawatts of generating capacity requires 200 hectares of land; with wind, 14,500 hectares is needed and with solar panels, 4,800 hectares. According to physicists Anastassia Makarieva, Victor Gorshkov and Bai-Lian Li, wind would never be able to match even existing hydrological dams, much less coal, oil or gas, and renewables as a whole could not supply more than 10 per cent of current energy consumption without destroying the delivery of "critical natural energy flows".[76]

As will be explored further in the next section, the triple combination of fossil fuels, heat engines and commodified labour also made finance what it is today. In addition to reinforcing a notion of "unlimited good" unrestrained by the need to consider the welfare of the community, it helped, in the words of Elmar Altvater, liberate compound interest from any "stigma of socially destructive and sinful usury",[77] giving wings to the delusions that are central to the workings of today's highly-financialized societies. On the one hand, it promised sustained profit – and interest – on a scale never before seen. On the other, it forced industry into an unprecedented spiral of expenditure on machinery, engendering a tendency of the rate of that profit to fall over time, with all the impetus toward financial and other crisis that portended.[78] In other ways as well, it helped lay the foundations for characteristic present-day financial bubbles involving land, credit and rent – including through the invention and development of suburbia.

The contribution of fossil fuels to the emergence of thermodynamic energy was far from passive. If machines are frozen or "dead" labour, as Marx suggested, they are also what geographer Matthew Huber calls frozen or "dead ecologies" in the sense that they rely on the "work" of untold generations of past nonhuman life.[79] Today, machines are able to supersede the circular time of the days and seasons only by burning up 400 years' worth of global plant growth every year.[80] Without that accumulation of ancient growth, they would be just a pile of junk.

As many post-Soviet farmers have experienced, when there is no longer any diesel for a piece of agricultural machinery, it is just an assemblage of scrap metal.

Why is Energy not Old?

Long before the concept of energy emerged in 19th century Europe, people knew how to convert heat into motion. Two thousand years ago, the Greek engineer Hero assembled a toy engine that used jets of steam to rotate a sphere, and Chinese inventors may also have developed models of steam engines for carriages and boats very early on.

People were also adept at finding ways of converting animal to mechanical energy, with ancient Chinese inventions such as chest and shoulder harnesses often leading the way. Long before Europe, China also pioneered a number of ingenious inventions designed to lift huge masses (in this case water) a certain height – the thermodynamic definition of work – and to convert rotational into longitudinal movement and improve the operation of pistons and cylinders.

Pre-19th-century societies also knew all about fossil fuels. Coal and oil were known in ancient times, and in both China and Britain, coal replaced wood in many uses long before the industrial revolution.

Nor was there ever any lack of interest in regimenting labour. Even in Pharoanic Egypt, elites tried to "mechanize" the organization of labour on a massive scale.

Why, then, did it take so long for the modern omnibus concept of thermodynamic energy, and the modern energy regime, to emerge?

The answers are not completely clear. But the existence of the question itself suggests that it was only through the fusion of a wide range of political, technical, financial and fossil-fuel elements in a new way of mobilizing and appropriating surpluses that the Big-E Energy we know today emerged.

One reason Hero's steam engine did not lead to a concept of thermodynamic energy, or an industrial revolution, was because it was not about capitalist work. Hero's interests lay not in increasing the productivity of labour but in religious and artistic activities. Other inventions of his included a heat engine for opening temple doors and a mechanical theatre complete with artificial thunder machine. Hero could no more have imagined using his steam engine for purposes of capital accumulation than James Watt could have imagined using his for subsistence, comfort or just plain fun.

In China, meanwhile, thermodynamic concerns may never have risen to the fore partly because labour-intensive rice cultivation and irrigated agriculture featured few incentives for capital investments in machines and fossil fuel or for the development of an "energy sector".

In Europe, without a technocracy of engine-building (based partly on a tradition of crafting smaller instruments), there would have been no steam engines to pump water out of the chronically-wet regional coal and iron mines, and without the needs of the mining and metallurgical industries for pumping, hammering and rail transport,steam engines and the coal that fuelled them could not have become so widely entrenched. Similarly, without British "cotton plantation colonialism" in the Americas and the politically-engineered destruction of India's textile export industry, there would not have been so many steam engines in the British Isles themselves.

Sources:

Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages*, Zed, London, 1991;

Kenneth Pomerantz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy*, Princeton University Press, Princeton, 2001.

The Second Law of Thermodynamics

If the First Law of Thermodynamics constituted a euphoric rallying cry for an emerging 19th-century industrialism, the Second Law, in the words of energy scholar and activist George Caffentzis, "laced this high with arsenic".[81] The Second Law stated that energy, in the course of being converted from one form to another in an engine, always lost some capacity to do work – or, in a revealing piece of jargon, a certain amount of "order". You couldn't take all of the waste heat given off by a steam engine, recycle it back into the machine, and keep it running forever on the same lump of coal. Once heat went from a hot to a cold body, it couldn't go back. The energy expended in manufacturing could never be fully recovered or recycled in a way that would be useful for capital accumulation. Perpetual motion machines could never be anything but a fantasy.

The upshot was that machines could create products (like an iron bar) that locally represented a higher degree of order than their raw materials (iron ore) only at the cost of decreasing the *overall* amount of order (or available work) globally – that is, at the cost of increasing the overall proportion of "waste" in their environment. Machines didn't destroy any energy – as the First Law stated, that was impossible – but they did "degrade" it. In particular, they took the "high-quality" energy of coal or oil and turned it into energy that was less useful for business. In energy terms, it turned out, "finished" products represented overall deterioriation – a conclusion disturbing for capitalist mythology, and one that required some adjustments and dressing up.

For the overwhelming majority of past, present and future human societies, neither the First Law nor the Second Law are particularly important. The Second Law is no more terrifying than the First Law is thrilling. Societies that can sustain themselves with constant infusions of high-quality energy from an outside solar source, and that have little drive to commensurate all forms of energy into a mobile, commodified form, can reproduce themselves indefinitely without needing to fret about, or even formulate, either law.[82] Whatever "order" they might need to sustain themselves is replenishable. The cycles that sustain life are never confused with the profit-making perpetual motion machines of modern European fantasy, nor the fictions of equal exchange that orthodox mathematical economics relies on.

Industrial "cyborg" societies – which revolve around a "technomass"[83] constituted by fossil-fuelled engines and worker-machine, consumer-machine and land-machine hybrids (*see* "Cyborg Workers", "Cyborg Consumers", and "Cyborg Plants, Cyborg Land" below) – are different. Such structures can reproduce themselves only through ever-accelerating degradation of the finite, inorganic energy sources they rely on. Their corporations can keep their machines running – increasing the productivity of labour to outcompete their rivals – only by importing "order" or high-quality energy (coal, oil and gas) and degrading it into "disorder" in the form of carbon dioxide and other waste outputs. If, for these societies, survival amounts to capital accumulation, capital accumulation means depleting the stocks of negative entropy (or order) that keep the productivity of cyborg workers or "human machines" on the increase.[84]

Such societies' "technomass" can be sustained only by trading high-priced manufactured goods for discount-priced high-quality energy. As anthropologist Alf Hornborg writes, "unequal exchange in the world system is what reproduces machines, and machines are what reproduce unequal exchange".[85] For such a system to work, a "decrease in total energy quality" must be matched by "increases in value" in production,[86] so that "the more resources that have been dissipated by industry today, the more new resources it will be able to purchase tomorrow".[87] Economic growth via Big-E Energy thus entails a vicious cycling between the build-up of technological infrastructure and the capacity (through the symbols or ideology of prices) to make more and more claims on other people's land and work. Fossil capital, sociologist Andreas Malm concludes, is a "*process*, a flow of successive valorisations, at every stage claiming a larger body of fossil energy to burn [that] recognises no end".[88] Far from being "labour-saving", industrial machines are a contrivance "for outworking other populations in order to outdistance them in trade" (*see* Box: "Does Energy Really Save Labour? Is Energy Really a 'Slave'?"). Instead of ecological damage being correctible by "proper pricing of natural resources and pollution", profitable exchange depends utterly on maintaining inequality-based prices that multiply energy degradation and assaults on subsistence.

Big-E Energy, then, not only exacerbated inequalities, but also generalized them worldwide in an ever-renewing dynamic. "Before the upheavals of the Industrial Revolution," writes economist Paul Bairoch, "the average country in the future Third World was probably not poorer than a similar region in the future developed world; certainly not much poorer, for example not as much as 20 per cent poorer".[90] A century later, it was clear that "the condition for energy abundance in a small number of countries" was not only global ecological degradation – by around 1900 US elites already had a vision of "foreign rivers to be turned into electric power and light"[91] – but also "energy scarcity for the majority of humanity."[92]

For societies that benefited, the First Law of Thermodynamics was important in that it symbolized in a seemingly "nonpolitical" form the way plural "energies" could be disentangled from the commons in order to be be combined with machines to generate surplus from labour to pass up a pyramidal hierarchy. In the words of Swiss architect Jean Robert, it became a useful "Trojan horse for a contamination of common sense by ecologically and socially unsound representations" and a spur to "destructive R&D" on energy needs, resources, economies and wars; the transformation of individuals into "efficient and productive processes"; and a whole discourse on how to "optimize the relation between 'energy resoucres' and 'energy needs'."[93]

The Second Law, meanwhile, was an essential caution against inferring from the interconvertibility and indestructibility of energy that a capitalist nirvana of limitless accumulation was in the offing that would not involve accelerated depletion of terrestrial stores of high-quality fossil energy. It was a reminder of the need to be militant, for as long as possible, in pursuing both unequal exchange and efficiency in the political struggle for profit; already by the 1850s, it was clear that industrial supremacy would lie with the countries that not only possessed, but also most efficiently used, the existing supply of the world's labour power and fossil-fuelled technology. "Do not waste

energy!", urged German chemist Wilhelm Ostwald in 1912, while his British colleague Frederick Soddy proposed a new economics that took better account of the Second Law.[94] In the later 20th century, the Second Law also became a reminder to capital of the need to be militant in defending a modified price system as a "solution" to ecological crisis. If "correct pricing" could be presented as a sufficient corrective for environmental problems, the role of price itself in the maintenance of unequal exchange could be ignored.

Thermodynamics delivers its messages in a form conducive to political myth-making. The First Law says that an omnibus, commodification-ready Energy has *always* been there, waiting to be enlisted by industry. "Humans have always used energy – they just didn't always know it," goes the refrain, ever since the hunter-gatherers of 10,000 years ago collected the "energy equivalent of 1.5 barrels of oil a year from plants and animals".[95] There is, to cite the words of physicist R. Bruce Lindsay, "constancy in the midst of change".[96] Beneath the simplified ideological label "the conservation of energy", thermodynamics conceals the violence of the historical processes of enclosure that made Big-E Energy a palpable reality.

Similarly, while the Second Law does not deny the destructiveness of an exploitative energy system that exacerbates inequalities in the course of creating accelerating scarcities of thermodynamic work, it depoliticizes and decontextualizes those scarcities by casting them as merely one facet of the entire universe's tragic yet inevitable trajectory toward an ultimate running-down or "heat death". This vision of a seemingly-inexorable breakdown of cosmic order, against which all human efforts of amelioration are mere stopgaps, appealed to many 19th-century European and North American intellectuals' taste for melodrama – and their desire to justify the effects of the growing industrial system. The universal "heat death" envisioned by the Second Law of Thermodynamics was similar to the apocalypse portended by the mythical "vast hordes" of Malthusian population increase.[97] Both mythologies concealed the historically-specific nature of the social arrangements that had – only fairly recently – created energy scarcity and a sharp, supposedly eternal opposition between "society" and "nature".

Sectoralization of Energy

One concrete sign of the emergence of thermodynamic or Big-E Energy (together with the new combination of heat engines, fossil fuels and generalized wage labour) was the birth of an identifiable, autonomous industry or sector specializing in generalized power sources rather than in products such as textiles, metals, carriages or agricultural crops.

A distinct "energy sector" had not existed in preindustrial times. Farms had their animals, ironworks had their charcoal fires, sailing ships had their prevailing winds. "Energy" had not yet been disentangled from muscles, fire, wind and water currents employed for particular purposes in particular locations. In Europe, the multipurpose rotary power that water mills could supply for grain milling, ore hammering or textile manufacture – often under the control of feudal powers – might be said to have marked a hazy beginning to what would later be characterized as an "energy industry". Also significant was the increasingly extractive

Does Energy Really Save Labour? Is Energy Really a 'Slave'?

The ability of fossil fuel-powered engines and machines to perform immense amounts of thermodynamic "work" has often thrown intellectuals into a kind of delirium.

On the one hand, figures such as early 19th-century British engineer John Farey have tried to calculate how much such machines add to, or compete with, the existing labour force. In 1827, Farey reckoned that 750 people in a mechanized cotton mill could spin as much thread as 200,000 people on their own. French utopian socialist Charles Fourier claimed that in Britain alone, the work done by "various mechanical inventions" – "patient, obedient, submissive, from whom no rebellion need be feared" – already equalled that done by "two hundred millions to four hundred millions of working adults". Both at the time and afterwards, workers worried about being temporarily or permanently thrown out of work by technological advances powered by fossil-fuelled engines, while traditional aristocrats fretted about their power and status being usurped by industrial upstarts armed with the latest mechanical devices. Long before Arnold Schwarzenegger arrived on the scene, the flip side of the image of machines as docile servants was the image of machines as malignant Terminators.

Others, meanwhile, looked at the issue from a different angle, trying to calculate how much human toil and drudgery might be "saved" by fossil-driven machines. Two centuries ago, astronomer William Herschel enthused that a mere two pounds of coal could lift you to the summit of Mont Blanc, while the coal it took to supply a foundry for only one week could raise the Great Pyramid. Later on, brilliant intellectuals such as John Maynard Keynes assumed as a matter of course that fossil-driven machines eventually ought to lighten the load of labour. This assumption persists today in the catch-phrase "labour-saving device" and the belief that drudgery and suffering in the global South can be relieved by "transfers" of the right kind of technology (hydroelectric dams or solar-powered washing machines) or by crash programmes ensuring "energy for all". As recently as 1995, US author Jeremy Rifkin claimed that advances in technology would finally make real the "age-old utopian dream of substituting machines for human labour, finally freeing humanity to journey into a post-market era" in which people worked reduced hours in a non-profit or volunteer sector.

Energy Slaves

The two threads – of machines outdoing humans and machines serving humans – are commonly woven together in the claim that the industrial revolution has supplied millions of nonhuman "slaves" which *both* add to the labour force *and* relieve everyone's toil, through the use of increasing amounts of high-quality energy per labourer. A 1915 General Electric advertisement put pictures of the "slaves of yesterday" (downtrodden toilers erecting pyramids) alongside those of the "slaves of today" (dynamos, turbines, trains). Shortly afterwards, the radiochemist and alternative economist Frederick Soddy pointed out how fast "science" was augmenting these "patient armies of inanimate slaves". By the time that futurist Buckminster Fuller coined the term "energy slave" in the early 1940s, he was able to claim that approximately 36,850,000,000 inanimate slaves were toiling away on behalf of civilization.

In the 1950s, the theme was taken up by US Admiral Hyman Rickover, who told fellow citizens that each of them was the "master of an army of mechanical slaves". Every US industrial worker, Rickover estimated, had the equivalent of 244 men at their service in the factory, while at least 2,000 pushed each car along on the road and another 33 served as faithful household helpers. Each locomotive engineer commanded the equivalent of 100,000 slaves, each jet pilot 700,000. The message was that US workers lived like kings; as anthropologist Joseph Tainter now puts it, while a Roman family might have commanded half a dozen human slaves, an average North American family employs 400. Robert L. Bradley, a former Enron executive now doing research for oil corporation ExxonMobil, similarly celebrates the fact that the proportion of industrial work performed by human hands in the US has gone down from 90 to 8 per cent in a century.

The notion that energy and human slaves might be substitutes for each other was also advanced by early 20th-century journalist Hendrik Willem van Loon, who declared that the "amount of mechanical development will

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always be in inverse ratio to the number of slaves at a country's disposal". Physicist Alfred Rene Ubbelohde, meanwhile, thought that slavery had probably prevented the steam engine from being developed further in ancient times. More recently, environmental journalist Andrew Nikiforuk, while he concedes that "mechanical slaves, powered first by coal and later by oil" in many cases made human "conditions worse for decades," insists that they nevertheless eventually eliminated the "need" [sic] for "widespread human slavery and serfdom".

Other proponents of the "slave" metaphor use it more as a warning that owners of energy slaves are likely to degrade themselves as much as do owners of human slaves. In 1974, for example, Ivan Illich warned that in high-energy societies such as the US, "man [sic] is born into perpetual dependence on slaves which he must painfully learn to master." Once the "voracious hordes of energy slaves outnumber people by a certain proportion", he wrote, the result is ubiquitous "inequity, harriedness and impotence":

> "The energy crisis focuses concern on the scarcity of fodder for these slaves. I prefer to ask whether free men need them . . . no society can have a population that is hooked on progressively larger numbers of energy slaves and whose members are also autonomously active."

For even a few classes of people to be able to attain speeds of even 15 miles per hour, Illich added, already begins to undermine possibilities of equality and to increase "time scarcity related to traffic".

Questioning the Slave Comparison

The idea that energy is a servant or slave – that it can replace human work – was encouraged by the energetic model of labour associated with 19th-century thermodynamics. But, as energy scholars Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery point out, work is "far from being a mere expenditure of energy": the "energy rent" is a mere addition to the "surplus produced by labour in its different historical forms". To geologist Earl Cook in the 1950s, as to anthropologist David Graeber in the 2010s, it was less accurate to say that the industrial energy regime replaced slavery than to say that it was based on it. Both were structures, Cook observed, "in which primary energy flow was controlled so that a surplus was assured for the managers". Long before either writer, Karl Marx had wryly observed in *Capital* that:

> "If someone says that 100 million people would be required in England to spin with the old spinning-wheel the cotton that is now spun with mules by 500,000 people, this does not mean that the mules took the place of those millions who never existed. It means only that many million workers would be required to replace the spinning machinery. If, on the other hand, we say that in England the power-loom threw 800,000 weavers onto the streets, we do not refer to existing machinery that would have to be replaced by a certain number of workers, but to an actually existing number of workers who were in fact replaced or displaced by the looms".

Historically speaking, energy-intensive industrialism has seldom shown many signs of "saving labour", much less eliminating work or even slavery, in its nearly two centuries of existence. Every time a "labour-saving" energy advance has been introduced in the workplace, the result has generally been new kinds of toil. Indeed, as philosopher Amy Wendling points out in her study of technology and alienation, in 19th-century capitalism, machines tended to appear as the sign of the "introduction of labour's more barbarous forms, not the progressive elimination of labour".This is because the function of machines was never simply to replace or substitute for labour, but rather to increase the productivity that could be appropriated. With machines, each worker employed could produce more under intensified working conditions; and those whose labour was "saved" in the sense of losing their jobs could join the ranks of the unemployed and, by thus depressing wages, contribute their own bit toward making businesses more productive per unit outlay. Along the way, workers' struggles could be countered with new types of threat, discipline and centralization. For example, as Debeir, Deléage and Hémery emphasize, the 19th-century spread of steam engines:

> ". . . was not designed to make the labour of weavers lighter, but simply to enable the owners of factories or workshops to produce more, faster and at lower costs. This first converter of thermal energy into mechanical energy had the effect, if not the goal, of establishing the domination of capital over labour".

Just as the centralized water mill had replaced the hand mill in medieval times not because it was "labour-saving", but rather because a monopoly on milling helped feudal lords extract more surplus from peasants, so too the steam engine replaced the water mill not because it offered technical "wins" equally to everybody involved, but because it enhanced employers' power and increased their share of the product (*see* Box: "Cotton and Steam").

The vast expansion of energy provision in China at the beginning of the 2000s, by the same token, was aimed not at lightening the burden on industrial labour but at exploiting it as cheaply and massively as possible (*see* "China as a New 'Chimney of the World'" below). Similarly, computers and robots have not heralded a new age of leisure, but merely a new age of labour. Clerks armed with Microsoft word processors and advanced photocopiers turn out hundreds more documents per day than 19th-century copyists working with pen and ink, but do not necessarily work shorter hours. As historian Moishe Postone sums it up, the "enormous increase in productivity under capitalism . . . does not result in a corresponding reduction of labor time and a positive transformation of the nature of work".

In addition, increased use of thermodynamic or Big-E Energy in machines in one place typically means an increase in toil and a degradation of work elsewhere. In 19th-century Britain, supposedly "labour-saving" machinery in the textiles industry could be kept running profitably only with raw materials provided by an army of enslaved or brutally exploited workers on plantations in the Americas. Sometimes the connections were geographically even closer. As historian Peter Linebaugh relates, with the sugar plantations introduced to Guyana during British rule came steam-powered mills which "saved" labour in the mills only by intensifying it in adjacent fields; hence, "*more* slavery, not less".

The supposedly "labour-saving" use of Big-E Energy in manufacturing and households has also historically increased drudgery in coal mines and oil fields and, no less importantly, degraded the livelihoods of the peoples displaced or contaminated by energy extraction worldwide. Few could argue that oil extraction by Shell in Nigeria, Texaco in Ecuador, or BP in the Canadian tar sands, or the flooding of arable and forest land in Asia, Africa and Latin America by hydroelectric dams, has in any way "saved the labour" or increased the leisure time of the indigenous residents. On the contrary, it has generally forced them into more precarious, impoverished and harried existences, on resettlement sites, in slums and reservations, and in the world of unfulfilling, low-paid labour. As social scientists such as Stephen Bunker and Alf Hornborg have argued, this is not an accidental aspect of today's energy economy, to be rectified by improved standards or "damage control", but is a necessary part of its structure. As in the 19th century, to quote Linebaugh's words, "expropriation from the commons and the mechanization of labour [work] upon each other as in a feedback loop".

The widespread mechanization of labour that thermodynamic energy made possible has also involved continual efforts to routinize human livelihood activity in highly industrialized countries in ways that remain in tension with its playful, solidarity-directed, commons-infused aspects of interaction (with humans and non-humans), attempting to substitute for them a maximally-productive ideal of "transformation" of an imaginary set of passive "natural" materials. The huge gouts of energy that became available in the age of fossil fuels, in other words, have entailed perpetually-redoubled and re-improvised efforts to enclose the commons of everyday workplace activity in the North as well as the commons of land, forests and water described by historians such as Karl Polanyi and E. P. Thompson and the commons of independent mobility described by critics such as Ivan Illich.

These efforts have never succeeded except partially, and it is impossible to imagine how they could. Indeed, capital's mechanization of livelihood works to the extent that it does only through the presence of oppositional reworkings of its logic, ranging from the enduring reluctance of early industrial labourers to be subjected to the time discipline of the workshop or factory to the continual efforts of workers today to humanize and continually re-humanize manufacturing and office work by engaging in "gaming", "making out", "re-commoning" or otherwise outwitting or subverting management and its efforts to get workers to police themselves through Total Quality Control and other fads. The persistence and ubiquity of commons-grounded "refusals of work" of all shapes and sizes in the central metropolises of a fossil-fuelled age are

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themselves evidence of the sheer sentimentality of claims that thermodynamic energy is someday going to liberate ordinary people from toil.

A final refutation of the notion that Big-E Energy relieves toil takes as its starting point the corporate imperative to build up an increasing mass of energy-hungry, productivity-boosting machinery in order to outcompete other corporations. Other things being equal, the more such machinery corporations buy, the more that recovering its costs will eat into profits, especially when the pace of competition in technological development makes it impossible to get the maximum use out of each machine before it becomes obsolete. One of the many ways of making up for that tendency for the rate of profit to drop, aside from economic depression, war, or other processes of capital destruction, is to find more workers to squeeze as well as ways of squeezing old types of worker harder or new types of worker in different ways. As energy scholar George Caffentzis points out, "the computer requires the sweatshop" and as Slovenian philosopher Slavoj Zizek quips, the US working class is not "disappearing", but to a large extent merely happens now to have a Chinese address.

Nuclear power stations and high-tech trading systems in one place demand that business "increase the total pool of surplus labour, help depress wages, and tremendously expand the labour market" elsewhere, instituting new labour-exploitation zones around the world, enclosing new lands, trying to appropriate free labour of consumers, and attempting to seize more rights over ideas and life forms. Moreover, in order to maintain an average rate of profit throughout the system, "branches of industry that employ very little labor but a lot of machinery must . . . have the right to call on the pool of value that high-labor, low-tech branches create". That includes the oil sector: ten percent of global gross domestic product goes to a petroleum sector that provides jobs for less than 0.1 percent of the world's population. Governments have traditionally played a key part in helping transfer part of the profits from other businesses to oil companies via tens of billions of dollars per year in subsidies ultimately gleaned from workers.

Insofar as fossil fuels are integral to this continuing rescue via productive labour, business as a whole cannot let go of them, whatever climate catastrophes or other distractions may ensue. Hence it is not only big, bad oil and car companies, or manufacturers that make especially heavy direct use of fossil fuels, that have a vested interest in resisting a transition away from fossil fuels. So too do corporations across the board, even those dependent on supposedly "immaterial" intellectual property, as well as the states whose budgets and, often, survival depend on how well they can adjust themselves to this business imperative. The official hysteria that invariably greets any serious popular effort to keep remaining fossil fuels in the ground – from the repression of students in Ecuador who oppose the exploitation of Yasuni National Park to the strident "drill, baby, drill" campaigns of the US – is a good index of how much is at stake for a business sector dependent on shares in the surplus derived from workers. So is the 30-year insouciance on the part of virtually all governments regarding the increasingly dire warnings of climate scientists about the future of the planet. On the global scale as well as the workshop scale, it is always "contact with living labor" in sufficient quantity which "resuscitates the value of the dead labor congealed in past products", whether industrial machinery, personal computers, or the fossil fuels that power them.

Sources:

Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012;

David Harvey, *A Companion to Marx's Capital*, Verso, London, 2010;

Ivan Illich, *Energy and Equity*, Calder and Boyars, London, 1974;

Jeremy Rifkin, *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era*, Putnam, New York, 1997;

David E. Nye, *Electrifying America: Social Meanings of a New Technology*, MIT Press, Cambridge, MA, 1997;

Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991;

David Graeber, *Debt: The First 5,000 Years,* Melville House, New York, 2012;

Amy Wendling, *Karl Marx on Technology and Alienation*, Palgrave Macmillan, London, 2011;

Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993;

Pierre Dockes, *Medieval Slavery and Liberation*, University of Chicago Press, Chicago, 1982;

Peter Linebaugh, *Ned Ludd and Queen Mab: Machine-Breaking, Romanticism and the Several Commons of 1811-12*, PM Press, Oakland, 2012;

George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013.

treatment of forests that became widespread during the "proto-industrial" era in which some rural areas, especially mountainous and forested ones,[98] became dependent on mass production for distant markets. But it was not until the age of coal-fired steam engines that a term like "energy sector" begins to become appropriate. Even in China, where techniques of harnessing water, wind, muscle and fossil power for agriculture, transport and metallurgy – including camshafts, coking and dual-action pistons and cylinders – had been far in advance of those of Europe since ancient times,[99] and where there had long been hydraulic bureaucracies, nothing resembling an autonomous "energy sector", energy companies, energy bureaucracies, energy technocracies, or concept of Big-E Energy emerged until the age of the steam engine and thermodynamics.[100]

In 1784, James Watt, significantly, portrayed his machine not "as an invention for a particular purpose, but as an agent *universally* applicable in industry", whether silk, cotton or metallurgy; by 1851, Watt and Boulton's firm was sending "steam engines of colossal size for ocean steamers" to the Great Exhibition in London.[101] With easily-transportable coal, steam engines became mobile prime movers "of universal technical application" across all sectors,[102] making coal – and whatever equivalent could be contrived for it – an apt candidate for a major sector of its own.

From the beginning of the fossil fuel era, fuel companies were also international transport companies, integrating "upstream" and "downstream" in the supply chain. In Europe, transporting pinewood only a few kilometres on carts or 10-16 kilometres on inland waterways had doubled its price,[103] making a wide-ranging wood-fuel trade improbable, but coal, with its high energy concentration, could be economically traded across whole oceans even by sailing ship, and more so following the advent of the steam transport that coal itself made possible. Hence Britain, with its big coal deposits and vast coastal and international merchant marine, had an advantage in building up a prototype for an "energy sector", which in turn helped it gain the power over the industrial trade goods market that gave it such an edge over its colonies and competitors. Later on, the railway, which, like the steam engine, had itself been born in coal mines, also proved key to energy transport; in fact, the first intercity railways were coal-carrying lines.[104] Oil pipelines later turned out to be almost 100 times cheaper still per unit cost,[105] and electricity transport via high-voltage lines was, of course, even cheaper.

Under the colonialist drive to assimilate "upstream" resources, nascent European "energy sector" actors took over other continents' coalfields and hydrocarbon reserves, which were usually developed only insofar as they were controlled by British, Dutch, German, French, Belgian or Russian financial groups. In the two decades before the First World War, international oil companies appropriated almost all main oil reserves globally. Before the oil shocks of the 1970s, the major international oil companies still owned 61 per cent of property rights over crude oil produced in non-socialist countries. Subsequent nationalizations little affected this tendency toward centralized control.[106] Before and after, the state remained crucial to the maintenance of the global "upstream" of energy sources: it is estimated that between 1976 and 2007 the US military alone spent an average of US$ 225 billion per year solely on oil supply protection in the Persian Gulf.[107] Reciprocally, military activities themselves are highly dependent on oil, including – as the US war against Iraq and

its aftermath demonstrated – those that periodically destroy capital so that accumulation can make a fresh start.

On the downstream side, tycoon John D. Rockefeller established dominance over the US oil industry early on by gaining a stranglehold over transport and distribution. Just as early coal companies had been transport companies, today's oil companies control about one-third of the tanker fleet as well as other maritime traffic, in addition to three-quarters of refinery capacity and distribution and virtually all exploration data. Other companies sought hegemony over large electrical networks and other energy distribution chains, further integrating energy not only with transport but also with finance. Starting early on, a company like General Electric (GE) made sure to keep its fingers in a variety of pies ranging from power distribution to electric motors and, eventually, nuclear plants. Thomas Edison himself, as a founder of one of GE's parent companies, had been clear about the need for an integrated approach, realizing that entrenchment of electricity required distribution networks, political connections and serious finance as much as dynamos and light bulbs.[108] In the mid-20th century, his business heir, Samuel Insull, served successively as vice chair of GE and organizer of Chicago Electric Power, where he placed his orders for power generation and distribution equipment with his old company. By the early 20th century, the bias toward monopoly had spread to the Soviet Union, whose leaders enthusiastically embraced the idea of giant, centralized electricity projects and exportable fossil fuel surpluses. All such trends, of course, fed the growth of corps of specialized technocrats and traders intent on their own survival and reproduction – another aspect of sectoralization.

The whole process brought the field of industrial energy under the sway of private and state firms that were to grow into some of the largest in the world.[109] Even in the early 19th century, the big players in the UK's Northeast coal trade were "among the largest firms in the country",[110] while in France in 1840, 11 out of the 20 firms with the largest capital were engaged in coal mining, in which a quarter of the 20 companies' capital was concentrated. Today, seven of the world's ten largest corporations belong to a distinguishable "energy sector" (two owned by the Communist Party of China) – a proportion inconceivable at the time of the emergence of the steam engine.[111] The oil industry alone extracts more than $2.3 trillion in oil and gas from the ground annually, making it the world's most profitable enterprise.[112] The overproduction and surpluses endemic to the fossil fuel industry – a symptom arising partly from the nature of Big-E Energy itself – has made planned demand essential, reinforcing solidarity among participants in the energy sector (*see* Box: "Energy and Planned Economies").

The crowning touch to the emergence of an "energy sector" came in the 1980s when oil companies, branching out into coal, synthetic fuels, renewables and oil trading partly as a way of dealing with nationalization, started calling themselves "energy corporations". While the phrase "energy distribution" had been used from the early 20th century, and the terms "energy crisis" and "energy policy" since the 1970s, "energy politics", "energy poverty", "energy efficiency" and "energy sector" itself did not appear until a decade later.[113]

Energy Networks and the Generalization of Consumption

If the emergence of a distinct energy sector was connected with the generalization of wage labour relations throughout whole societies, it was also tied to the expansion of networks that made a new type of mass consumption possible. Two networks were central: electricity and oil. As electric motors and oil-driven transport began to play a larger role in shaping life on the job, electricity-powered household devices and individualized internal combustion engines increasingly shaped time outside work.

Moving beyond coal transport networks toward an all-encompassing system of alternating-current electricity lines was one part of the change. US corporations sought to profit from electricity distribution by buying up and merging regional electricity networks into larger, centralized grids whose load could then be distributed judiciously. By 1937, the New Deal government, which viewed lack of efficient transmission and distribution of electricity as one of industry's main problems, was backing further consolidation. While total US commercial energy production expanded by a factor of only 1.8 between 1920 and 1950, electricity production went up by a factor of 7.8. Between 1950 and 1975 increases in electricity output continued to outpace overall growth.[114] A lot of this growth went to industry and municipalities, but the more notable surge was in lighting homes and powering the millions of new electrical consumer goods – tiny, distributed energy converters – that extended the reach of centralized energy networks into the furthest corners of everyday life. If, between 1820 and 1870, coal had moved from being mainly a source of domestic heating toward being overwhelmingly devoted to manufacturing, the later 20th century, thanks partly to the new networks, saw its energy shifting somewhat back toward home use.

In Europe, network unification was slower and – at least at first – less oriented around the expansion of consumption. In Germany, electricity networks were controlled by steel magnates owning coal mines. In the UK, the state had reduced the original multitude of networks from 491 to 144 by 1935, although there were still 43 different voltages in operation in that year. In France, the network was not unified until 1946. Mass electricity consumption on the US model developed belatedly. During the Depression of the 1930s, households were unable to pick up the slack in demand brought about by reduced industrial use, leading to excess capacity after 1935, although mass consumption began to surge after the Second World War.[115] Only later were gigantic grids also assembled in many countries of the global South, generally to serve industry first and mass consumption second. The share of electricity in world consumption of commercial energy went from 12 per cent in 1950 to 16 per cent in 1960, 22 per cent in 1972, and 25.5 per cent in 1979.[116]

The internal combustion engine and the infrastructure supporting it formed another part of the "electric-oil-auto complex"[117] that impelled what geographer Matthew Huber calls the privatization of social space and reproductive work[118] that occurred first in the US. The mid-20th

century development of suburbia was a vast, innovative means of simultaneously absorbing surplus capital, boosting demand and crafting a compromise between business and one segment of labour (the white, male one) – a compromise capable of meeting the "serious legitimation crisis of capitalist social relations" that loomed in the 1930s.[119] But it entrenched fossil fuels even more deeply within the world of the family and the home. In 1935, the great bulk of the energy produced in the US was generated by cars, not thermal power stations.[120]

Key to the further build-up of an oil consumption network was the drop in its price relative to coal that materialized in the 1950s.[121] Petroleum use quickly spread further through transport, electricity generation, and the chemical and agricultural industries, becoming the main source of thermal energy measured in value.[122] The share of oil in world primary energy generation rose from one-quarter in 1949 to nearly one-half in 1973.[123] While coal generated almost all electricity in the early 1950s, the figure in 1973 was down to 48 per cent, subsequently rebounding to 69 per cent in 1987 after the oil price surges of the 1970s.[124] As expanding energy infrastructure facilitated the exploitation of labour, sped up the extraction of raw materials, and accelerated turnover in markets, most North Americans, and then Europeans, became captive clients of oil and car companies in addition to electric power and appliance firms. Via low prices, oil imperialism in the Middle East and elsewhere became tightly linked to the remaking of everyday life in almost all its aspects, forging links of dependency that, as the oil companies were well aware, would be hard to break when prices later rose. Today, North Americans use up to 50 barrels of oil equivalent per year per person.

Energy and Planned Economies

All economies are planned economies. The only question is who does what kind of planning, against what opposition, and with what unforeseen or disastrous results.

Planning is inherent in the very concept of a market economy. The notion of an "economy" was invented between the 1930s and 1950s as a theoretical space of interaction whose output of goods and circulation of money and property could supposedly be centrally managed and made to "grow", defined by statistics that imperialist states found useful in deciding how to relate to colonies and satellites. During the same period, economist Ronald Coase, later of the University of Chicago, wrote a classic article arguing that the central actor of the contemporary market – the corporation – was itself a haven of non-market planning devised in order to avoid certain "transaction costs" connected with market dealings.

This planning cannot but stretch far outside the boundaries of any individual firm. As the distinguished economist John Kenneth Galbraith put it in his classic *The New Industrial State*, the planning system for the US economy (which he estimated in the 1960s to consist of "at the most" 2,000 large corporations) has no truck whatsoever with the imaginary market economy of neoclassical economics. The large-scale technological networks, long lead times, and huge investments in product lines characteristic of the modern industrial system mean that corporations simply cannot survive unless they can exert sufficient long-term control over costs, prices, demand, supply, sources of finance and political discourse, as well as secure the "help and protection of the state" and foster "deeply symbiotic" relationships between private and public bureaucracies. For corporations to respect "sovereignty of the consumer", "subordination of the firm to the market" or any other such neoclassical slogan would be fatal to themselves and to the system, which, Galbraith wrote, deploys "elaborate science and art to *suppress* market influences and make prices and amounts sold subject to the largest possible measure of control".

Today's global "free market", as University of Missouri economist Michael Hudson points out, is also a form of central planning, but this time conducted "by the banks and high finance – by Wall Street, the City of London, Frankfurt, the Paris Bourse and centres further eastward":

> "Their plan involves untaxing rentier income and wealth, headed by land-price gains . . . and financial deregulation. This shifts the allocation of capital out of the hands of government into those of the banking sector . . . The business plan of finance capital is to expand interest and amortization charges to the point where they absorb all disposable consumer income over and above essentials, all business cash flow and real estate rent over and above break-even costs, and government revenue over basic police and other necessary functions."

Under this regime, the chief executive officers of the major corporations about which Galbraith wrote decades earlier are now "concerned mainly with financial strategy, not industrial engineering, labour relations or sales." This "financialization of the economy," Hudson goes on, "is more centralized than public planning by elected officials":

> "And whereas government planning tends to be long-term, financial planning under neoliberalized conditions is hit-and-run. Whereas government planning is supposed to promote capital formation and full employment, today's financial planning makes returns by stripping assets, inflating asset prices (the Bubble Economy) and minimizing the return to labour relative to rentier returns."

Energy

The ubiquity of central planning in market economies is closely tied up with the dominance of thermodynamic or Big-E Energy in their workings.

With the type of fossil-fuelled production pioneered in the US by Henry Ford, heavy intervention by the state in all economic affairs became indispensable. Big banking and big government became "unavoidable". Large oil, electricity and automotive corporations that financially, commercially and technologically dominated the energy chains of industrialized countries also had no choice but to "shape consumption to suit their own needs".

Some of this is reflected in well-known corporate "conspiracies" such as General Motors' buyout of supply contracts for dozens of US urban public transit systems in the 1930s and 1940s in order to destroy their infrastructure and promote car use and suburbia. Also often cited are efforts by oil companies to lure buyers into structuring their activities around the premise on low prices, then putting prices up once customers are dependent, or to charge customers for Middle East oil at higher Gulf of Mexico prices.

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But the issue is far more serious than just a few "conspiracies". Among fossil fuel corporations, large scale, sunk capital, network distribution and a tendency to overproduce means not only that supply anticipates demand, but also that demand planning is essential. In 1910, Europe had a 3.6 per cent surplus of coal, with its six most industrialized countries enjoying a 12 per cent cushion over consumption. Early on, oil companies' need to create a market for the waste product of petroleum refining known as petrol or gasoline was met by helping make sure that automobile propulsion was organized around the substance, enabling them to levy a rent on an entire technological sysem and its infrastructure. In 1928, oil overproduction led to the Achnacarry Agreement, through which the major oil firms set global production quotas; in 1931, Oklahoma and Texas had to declare martial law and call out the National Guard to enforce some scarcity in the market. This dynamic is related to the commitment of almost all states and international agencies to wildly-exaggerated forecasts of energy demand, although this commitment arises also partly as a result of the nature of Big-E Energy itself. Meanwhile, the fact that the ratio of so-called "known oil reserves" to output remained so stable over so many decades hints at some planning agreement that proceeds independently of what might or might not be in the ground; even "peak oil" has not proved to be an overwhelming obstacle to oil companies' constructing paper "reserves" said to be extractable at reasonable cost.

Even more important to so-called market economies such as the US has been the more general 20th-century pattern of infrastructural, social or cultural planning promoting, for example, worker ownership of single-family suburban homes, automobiles, and the "multitude of other petroleum-derived products that saturate everyday life". This pattern was pursued as assiduously by state planners (such as New Deal visionaries in the 1930s, or Robert Moses, who helped create an infrastructure biased toward middle-class automobility in New York) as by corporate bureaucracies. Since the time Winston Churchill was the British First Lord of the Admiralty, state planners have also been crucial in keeping the production of oil firms flowing to the military. As early as 1913, Henri Deterding, an early Royal Dutch Shell chairman, had been able to say with some confidence that, with oil, "produce first and consumption will follow", but succeeding industry figures have never lacked diligence in reinforcing the networks ensuring that consumption.

Electricity, too, has involved central planning ever since Thomas Edison grasped that the development of his inventions represented "not only a technique but a complete system" of finance, engineering, distribution and politics. In addition, as power networks were consolidated, the ratio between their capacity to produce and actual consumption at any particular moment needed to be managed for maximum efficiency. That meant not only that the consumption habits of different clients needed to be researched, but also that demand had to be stimulated during off-peak hours. Hydroelectric dams and wind and solar installations, because their generation of electricity is intermittent, also demand central planning when they are plugged into a grid, in order to make storage and demand smoothing possible.

And nuclear energy, with its overwhelming safety costs and need for centralized command and control, renders the notion of coordination through "market mechanisms" ludicrous.

The economic centrality of energy also necessitates planning how to share out the pool of surplus created in labour-heavy sections of the economy among crucial labour-light, technology-heavy energy firms, particularly oil companies. At the very least, this requires informal extra-market understandings, and at times, legislative action such as the US's Sherman anti-trust law, which was aimed partly at preventing an oil monopoly from undermining the profits of all other companies, or state redistribution efforts such as the longstanding, hundred-billion dollar US military expenditures in the Middle East. Britain's City of London financial district also continues to play a role as a planning centre for the redistribution of value taken from workers in other sectors to international energy companies.

Sources:

Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity,* University of California Press, Berkeley, 2002;

Ronald Coase, "The Nature of the Firm," *Economica*, Vol. 4, No. 16, 1937, pp.386–405;

John Kenneth Galbraith, *The New Industrial State*, Penguin, London, 1967;

Michael Hudson, *The Bubble and Beyond: Fictitious Capital, Debt Deflation and Global Crisis*, Islet, 2012;

Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages*, Zed, London, 1991;

Matthew T. Huber, "Enforcing Scarcity: Oil, Violence, and the Making of the Market", *Annals of the Association of American Geographers*, Vol. 101, No. 4, 2011, pp.816-826;

Robert Caro, *The Power Broker: Robert Moses and the Fall of New York*, Random House, New York, 2004.

Cyborg Workers

> **"Every technology is a human world, a form of humanised nature, that unifies virtually every aspect of human endeavour. To construct a technology is not merely to deploy materials and techniques; it is also to construct social and economic alliances, to invent new legal principles for social relations, and to provide powerful new vehicles for culturally-provided myths . . . Technology, in short, is a mystifying force of the first order, and it is rivalled only by language in its potential . . . for suspending us in webs of significance that we ourselves create."[125]**
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> **Bryan Pfaffenberger, 1988**

One way of telling the story of the rise of thermodynamic or Big-E Energy is to trace the ways that humans, land and machines powered by fossil fuels adapted to, fused with and changed each other, all evolving together into strange and constantly-shifting new composite forms. Three of the leading characters in the story can be imagined as the *cyborg worker*, the *cyborg consumer* and *cyborg land*.

As Karl Marx noted, the great coal-fired inventions of the early machine age "could be put into practice only because each inventor found a considerable number of skilled mechanical workers available,"[126] a legacy of an earlier period of craft and workshop organization. Once set up, moreover, those machines could help their owners make the colossal profits that were now possible only through a symbiosis with human labourers, whose capacity to provide a work commodity – to be a "working body" available for management – had been developed over centuries of anti-commons agitation on the part of the state, as well as habituation to new divisions of labour and models of personhood and long exposure to propagandizing in the style of French philosopher René Descartes and his British contemporary Thomas Hobbes.[127] Abstract, Big-E Energy could become a source of profits only if fused with abstract labour; both were fashioned and replenished through a continuing process of expropriation.

Yet in the process of "animating" the new machines, workers found themselves required to make still more adaptations. Workers had to adjust to machines' increasing speed and relentless pace as well as their indifference to sunrise, sunset, heat, cold, rain, festivals and saints' days. Because the new machines had to be worn out as quickly as possible (in order to get the most value out of them before obsolescence and lost profits loomed), labourers too had to be worked to the limit, and be ready to jump to new tasks when needed. In the ecstatic 1835 vision of Andrew Ure, one of the prophets of the industrial age:

> "How much more productive will industry be when it no longer depends on muscular efforts, which are by their nature inconstant and irregular, but deals only with mechanical guidelines, fingers and arms actuated with regularity and at high speed by an inexhaustible physical force".[128]

Later in the century, industry consultants such as Frederick Winslow Taylor took this vision one step further by advocating the "enforced standardization" of worker movements, methods and conditions in order

to assure "faster work" and the complete transfer of control (or "mind") from workers to management.[129]

All this gave rise to different kinds of body and different kinds of human. Whereas hand tools are extensions of the muscles, bones and nerves of individual humans, the workplace machines of the Industrial Revolution channeled through worker bodies an external, centralized Big-E Energy controlled by factory owners. Just as the body wielding the medieval plough or blacksmith's hammer is different from the body tending the blast furnace, so too the body cranking the clothes mangle or cutting off a section of bamboo for a drinking cup on a walk through the forest is different from the body tending the spinning machine, and different again from the body putting windshields on a certain number of cars per day on an assembly line, the body assembling a certain number of circuit breakers every hour with small electric screwdrivers, or the body appended to the gigantic machines that came to be necessary in order to make factory machines themselves. The aggregate or plural "worker body" is different too. In medieval agriculture, landowners adding bodies to their workforce could not easily increase their surplus beyond a certain point, but the aggregate or plural industrial "worker body" assembled in particular places was able to grow much larger. Geographer Graham Zabel goes so far as to claim that without the commercialization of fossil fuels, human numbers could not have gone much beyond one billion.[130]

Both strength and other capacities were affected. Peasants the world over, however slight or emaciated, have always conceived of themselves as possessing a species of "strength" – defined in different ways in different local idioms – that inveterate city-dwellers, however well-fed and muscular or inured to arduous factory labour, will always lack. In industrial centres, homegrown "strength" of this type, which is in many ways a skill,[131] tends to be supplanted by an abstract, energetic or thermodynamic "strength" that leaves labourers dominated by, or competing with, the alien and massively superior power of fossil-fuelled machines. Workers' activity is devalued or demoted as a result.

Similarly for other abilities. In advancing the cause of centralized control and accumulation, industrialism powered by Big-E Energy vastly accelerated a process of destruction of distributed knowledge and *sui generis* livelihood abilities. It might be an oversimplification to follow conventional histories and call this a process of simple "deskilling". While vast, variegated reservoirs of specialized, locally-adapted abilities were indeed lost, the new machine-human hybrids did result in the development of others – new craft knowledges, informally transmitted, of the type that human-nonhuman interaction of any kind will always demand and stimulate;[132] various mechanical, techie and nerd skills; and, pre-eminently and for the majority, the capacity to negotiate and survive mind- and body-numbing routines for a half-day and more at a stretch. Yet, in general, work practices were emptied of much of their previous variegated content and disengaged from "non-work" contexts, as many aspects of know-how were transferred to and circulated through machine hardware and machine routines and the bosses that managed them. Knowledge began to appear as just as alien a force as strength. Work in its non-industrial senses (*see* Box: "Keywords" above, and "Modern Conflicts over Work and Energy" below), with its knotted qualities, entanglements with embodied strength and particular skills,

and connections with specific, complete objects that are then used by workers themselves, or the people they know, tended to be simplified down, at least for business purposes, into a more standardized form. For owners, after all, it was moments of labour-time that were the "elements of profit",[133] not the flourishing or necessarily even the survival of the worker. The competitive dynamic was to make each such moment produce more and more of a single result – to increase, year by year, the "normal" productivity of each second, so that the time period identified with the performance of any identifiable task continually dropped.[134] As a tedious, gruelling or monotonous "working day" – to be endured or "gamed" – was divided off sharply from scarce "free time", "leisure" or "reproduction", intellectual or bodily interest in activities aimed at survival tended to be eroded – although there could of course never be a point at which all workers could become indifferent to every aspect of the "content" of their work, or the whole system would collapse.

The same processes and distinctions can be traced in those parts of the human organism usually referred to as tools, machines, instruments or prostheses. Hand tools, used in the context of nonindustrial work or commons, are aids to survival, subsistence and enjoyment. While shoulder harnesses, wheelbarrows and hammers save effort and make up for biological weaknesses, those who use them outside the context of industrial production, like today's do-it-yourselfers, almost never talk about their "efficiency". For them, the point of a lever, pulley or chisel is not abstract. Nor is it open-ended productivity improvement. Rather, it is the performance of a particular, known, task for which only a certain amount of force, or "energy", is appropriate (*see* "Modern Conflicts over Work and Energy" below). Nor is the point of such tools to wear them out as soon as possible before they become obsolete. On the contrary, the point is to preserve them, keep them bright, hold on to them for as long as possible. In that respect, DIY tools are much like musical instruments. Such tools, too, are made to be borrowed. Part of the pleasure of having them is to share them with friends that you trust.

Fossil-fuelled factory and office machines are similar to such tools – or to crutches, or wheelchairs or other parts of the environment – to the limited degree that they become, in a sense, part of the human body – like nature, "one of the organs of its activity"[135] – and enable people to do things it would be impossible to do without them. Just as the tool or the machine cannot work apart from human beings, human beings cannot survive without tools or machines.

But there are, of course, differences. Karl Marx (and later Charlie Chaplin in the film *Modern Times*) liked to portray human beings as having become appendages to machines rather than having made machines into part of themselves, which is what ordinary tools had been. Marx went as far as to say that when employed by capital, industrial machines are like "vampires" attached to the throat of living labour, sucking out their strength and skill and leaving only a husk behind. Early worker-rebels against mechanization, including the Luddites of the early 19th century, who are sometimes misinterpreted as holding an ignorant prejudice against "inhuman" machines or innovation as such, tended to express the tool-machine difference in other ways. Business itself intermittently falls back on a sentimentalized mythology of human beings as containing some crucial "essence" separate from both tools

and machines, in alternation with a thermodynamic view of labour that assimilates humans to inanimate machines. Understanding that it needs human beings, not just machines, to make profits, business nevertheless wants to avoid discussing what kind of human/machine amalgam people actually want to be. The topic of "how to keep a space open for the purely human in an inhuman economic world" provides a welcome diversion. All such moves, which imply that what is distinctive about industrialism or its machines is that some "essential human being" bounded at the surface of the skin is in danger of being assaulted by undead or inhuman beings "outside" itself, make it harder to discern the real differences between tools in commons and machines in capital accumulation.[136]

One of those genuine differences, of course, is that the machines are owned or managed by the manufacturer (or the stockholder, or the pension fund) rather than, say, the DIY-er, and function to maximize the extraction of surplus from workers. Their overriding purpose is to make a killing, not to make a living (to borrow journalist Andrew Nikiforuk's neat phrase), and to do that they must facilitate the extraction of more and more surplus from the labourers to whom they are appended. The continual innovations they embody are distinct in this way from the innovations that ordinary tools embody. More than their feverish, thundering, inanimate activity, it is this involvement in a dynamic of competition, profitability and corporate survival that distinguishes industrial machines from ordinary tools and gives force to the vampire comparison.

But another, related difference is that machines in industry, offices and commodity transport are hooked up to a non-organic energy source much larger than human muscles. This difference is qualitative as well as quantitative: such machines depend on Big-E Energy, the fungible, seemingly illimitable energy of thermodynamics, rather than the subsistence-directed little-e "energies" of specific commons tasks, which are limited by their entanglements with local biotic or hydrologic conditions and the necessities and characteristics of particular subsistence tasks. If there are limits to the amount of energy that can be run through industrial machines at any particular time, they are set by, roughly speaking, market/state coordination, not by democratic discussion. Its flow is centrally regulated by engineers, economists, politicians and ecologists, not by commoners. Abstract, quantifiable energy is part of the machine that helps constitute the cyborg worker just as the abstract, quantifiable labour of the cyborg worker is part of what constitutes that machine. The industrial cyborg worker, while on the job, accordingly ends up having different needs from the tool-constituted commoner.

Cyborg Consumers

> **"Our enormously productive economy demands that we make consumption our way of life, that we convert the buying and use of goods into rituals . . . We need things consumed, burned up, worn out, replaced, and discarded at an ever-increasing pace."[137]**
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> **Victor Lebow, *Journal of Retailing*, 1955**

Before industrialism, British subjects who had been expropriated through, for example, the "dissolution of the monastic orders, the

confiscation of church lands, the abolution of the guilds and confiscation of their property, the forcible ejection of the population from the land through the transformation of tillage into pasture, enclosures of commons, etc."[138] still tended to prefer vagabondage, beggary or subsistence through piecework to regular wage labour, which to many of them seemed like slavery. In order to become integrated into a system in which their work could make others rich, they first had to be criminalized, made hungry, confined in workhouses, or inducted into a wage regime so meagre that they had to toil all the time just to survive from one day to the next.

In mid-20th century North America and Europe, workers – or at least certain groups of white, male workers – were integrated into the evolving business system in a different way. They were now part of the structure through which demand for the tremendous productivity of industry was ensured and managed. They had to have enough wages to buy stuff. For a time, at least, keeping them on the job could not be a matter of reducing their salaries or subjecting them to the rigours of criminal law. It was more a question of transforming them into people with ever-growing needs for consumer goods, cars, suburban houses and, ultimately, "health services", "nature services" and the provision of bank credit that went with the lot. They would need to stay at work to meet the need to consume. They had to "work at consuming" in the home and on the road as well as toil in the office or factory. Indeed, by the late 20th century, consumption began to be seen as inputs to a process by which individuals, considered as mini-corporations, manufactured *themselves* and made themselves and their homes worthy of speculative investment (and thus dissolvable in the case of bankruptcy, as a corporation is dissolvable).[139] A new style of control over "worker bodies outside the workplace in the realm of social reproduction" had emerged in the form of a "material transformation of infrastructures of everyday existence" and a new mode of living, thinking, and feeling.[140]

Big-E Energy was as crucial to this process as it was to manufacturing itself. The cyborg consumer animated by and fused with the thermodynamic energy from oil and electricity networks had become as crucial to accumulation as the cyborg worker. In many cases, they were the same person, each role supporting the other. And the ever-increasing amounts of Big-E Energy that each required had to be cheap to keep markets churning in the face of the cost of more and more automation. In the US, the entire financial and retail sectors, and the segments of the global economy that depended on them, subsequently became perilously tied to the speculative investment opportunities grounded in the pattern of residential property-ownership characteristic of the age of cheap oil.

Cyborg Plants, Cyborg Land

If cyborg workers and cyborg consumers are fusions of human bodies with fossil fuel-powered machines, cyborg plants are similar fusions of crops and trees with fossil fuels, heat engines and a diminishing reserve of fertile soil. As part of the process by which fossil-powered machines ultimately facilitate new forms of work and life organization that "reach all the way down" into the finest details of how human beings live their lives, so too fossil fuels and machines come to reshape and enter into a symbiosis with the innermost lives of plants and farm animals.

This happens on multiple fronts. Cyborg plants that produce large quantities of food for workers with a minimum of human tenders are crucial to modern industry's continuing struggle to keep ordinary people divided from their own means of subsistence,[141] yet supplied with food cheap enough to keep labour costs to a minimum.[142] Mechanized, monocultural "factory farming" uses machine-friendly, high-yielding crop plants organized to maximize the human "nutrition" produced per unit of labour expended. If the political weakness of commoners in 16th-century Britain – making possible land tenure changes and the increased capitalization of farming – was one ingredient in the rise in agricultural productivity supporting the original industrial revolution,[143] cyborg plants and cyborg land stepped up to play a big role in the turbo-charged mechanized production of the 20th century.[144] Food regimes[145] were integrated into fossil-based energy regimes. The Soviet Union, for example, used oil-enhanced agriculture to move 80 million farmers into cities over its nearly 70-year existence.[146] During the last two decades of the 20th century, similarly, historically-low food prices facilitated partly by applying Big-E Energy to cheap new lands were crucial in enabling the entry into the global labour pool of as many as one billion new workers from China, India and the former Soviet Union at a time of declining profits.[147]

Since "moments are the elements of profit" in industrial fields as well as industrial factories and transport systems, constant efforts have to be made to reduce both human and plant labour time needed to yield a certain output. Just as the proportion of labourers' lives devoted to subsistence, "Saint Monday" and the like had to be cut to the bone in early industrial times, and the "working minute" of autoworkers accelerated from 45 to 57 seconds during the 20th century,[148] so today wheat, rice, maize and other plants have to be bred or engineered to grow faster and to "waste" less of their metabolism on non-nutritional outputs, and have to be cultivated in patterns allowing for their quick planting and harvesting by oil-propelled machines. The same is true, of course, of livestock. While it took 73 days to bring a chicken to its "harvest weight" in 1955, by 2005 the figure had fallen to 42 days,[149] and in 2012, in some places, to only 28.[150]

Production is boosted partly through the application of fossil fuel-derived nitrogen and petroleum-derived pesticides, herbicides, antibiotics and other agrochemicals. The coal-intensive Bosch-Haber fertilizer-manufacturing process that tripled crop yields during the 20th century now accounts for half the nitrogen in every human body.[151] Through mechanization and application of agrochemicals, French agricultural yields alone jumped three times between 1945 and 1975.[152] Overall, more than 20 per cent of world energy resources – most from the geologic past – now go into food production.

By the postwar period, gains in labour productivity had become concentrated more in agriculture than in manufacturing. Between 1950 and 1990, the labour productivity of agriculture in Western countries went up around 5.5 per cent per year, compared with only 3.5 per cent in manufacturing, reversing the 1850-1950 trend, which had seen labour productivity gains in industry outpacing those in agriculture by 0.7 per cent annually.[153] The flip side of the approximately eightfold increase in the labour productivity of advanced capitalist agriculture over the period, of course, was profligate energy consumption.[154] Between 1997 and 2002, the share of capital-intensive agriculture in overall US energy flow increases

rose to a surprising 80 per cent.[155] Up to now, the capitalization associated with productivity gains has been largely concentrated in the North. As of 1990, US wheat cultivation used only 0.5 per cent of the labour expended per unit of land area as China.[156] Over 5.2 horsepower of machine capacity was installed per agricultural hectare in the North, compared with barely 0.1 in the global South. Lower labour costs made much food production in the North "cheaper" than in the South,[157] contributing to incentives to dump agricultural products there.

In terms of energy output, all this capitalization is inefficient.[158] Cyborg plants' production of food per energy unit is poor compared to other types of plant-human fusion. Machine-assisted rice plants in Louisiana or Italy produce less grain per unit of energy expended than muscle-tended rice plants in the Philippines or China.[159] Machine-plant combinations in which the contribution of human bodies is low make less sense in energetic as well as ecological terms than human-plant combinations in which the contribution of human work is high.[160] The point, however, is labour productivity and mass production. Raising maize is more than one hundred times more labour-productive with fossil-powered machines than by hand. Whereas an ancient Roman farmer might have put in 350 hours of work over a year in order to be able to harvest a tonne of wheat, a contemporary farmer in the US midwest can produce the same amount out of high-yielding varieties in an hour, provided all the proper inputs and machinery are cheaply available.[161]

Recent pressures from finance capital have reinforced this logic. Having grown greatly in influence since the 1970s, the financial sector is now in a position to demand that agricultural enterprises keep boosting productivity in relation to an average rate of profit determined largely by non-agricultural enterprises, including financial institutions themselves. For this reason as well, cheap infusions of high-quality energy from the Carboniferous Era, as long as they can be maintained and applied effectively to the diminishing "soil frontier", render increasingly unfavourable returns on energetic investment politically irrelevant. Cyborg crops will be regarded as "productive" as long as they can take advantage of a process of dispersion of the high-quality energy obtained through unequal exchange with extraction zones, an unsustainable relationship with the geologic past, and sufficient expanses of land and other aspects of extra-human nature that are not yet too degraded to support the weight of fossil-fuelled mechanical, chemical and chromosomic inputs.[162]

This degradation – and the inability of neoliberalism to counter it through expedients such as ecosystem service trading[163] – may eventually prove devastating to cyborg plants and livestock and the accumulation regime they support. The blowbacks and exhaustions that have already resulted from the detailed reorganization or "subsumption"[164] of the nonhuman world to capital are already helping to drive the costs of basic production too high for them to be of much help in countering falling profits in the industrial system. Because, as geographer Jason W. Moore points out, "capitalization can do its work only to the extent that a rising quantum of biophysical nature can attach to the same level of capital investment", business may well run out of sufficiently pliant, uncapitalized extra-human nature to subsume through cyborg plants and the like before it runs out of stores of relatively uncapitalized "human nature" to proletarianize.[165]

Ruthless monoculturing, for example, exposes crops and trees to heightened risks from pests and the soil to risks of impoverishment, requiring further chemical inputs that in turn engender "superpests" and "superweeds". Bosch-Haber ammonia, meanwhile, alters plant metabolism in ways that reduce protein, mineral and vitamin content and increase nitrogen pollution, all the while masking an underlying loss of soil fertility that is bound eventually to "bite back" hard. Re-engineering crops to enable them to flourish under the new chemical regimes – whether it involves conventional breeding, cloning, genetic manipulation or nanotechnological innovation – has numerous unforeseen and effects rivalling nuclear energy in their unpredictability, including on varieties planted elsewhere that have not yet been re-engineered.[166]

Just as fossil-fuelled heat engines helped spread a decontextualized "labour time" understandable and measurable worldwide as a commodity that can produce anything, they helped homogenize "land" into an abstraction that, with the right mechanical and chemical inputs, could be treated according to the same centralized protocols in different locations across the globe. If applications of Big-E Energy to manufacturing contributed to the deskilling and alienation of workers, in agriculture they resulted in a loss of plants' biodiversity and adaptability to different or changing environments. If peasant bodily "strength" was often outflanked by thermodynamic energy, the "strength" understood by many peasants to reside in the soil itself [167] was undermined as well, resulting in highly-commodified food that they regarded as "weak" and unsustaining. "For total control," observes US writer-farmer Wendell Berry, "we have given up health".[168] The parallels between the dynamics of land capitalization and the dynamics of labour capitalization are likely to extend much further than a Cartesian or mechanistic view of the nonhuman will allow.

In the face of the productivity slowdowns that, on most accounts, are now afflicting all areas of industrial activity (accelerating the sometimes panicked, sometimes resigned tendency of many governments and corporations to grasp ever more desperately at the straw of financial engineering as a source of profit), renewed efforts are underway to increase the cyborg plant population of the global South via, for example, the multi-million-hectare "land grabs" currently being carried out by richer countries.[169] While the cereal surpluses of the industrialized North have always stemmed, directly or indirectly, from the occupation of Southern mineral and agricultural regions, a new chapter in this skewed relationship is thus now being opened. With the bulk of cultivable global land now given over to grains for export, most crop plants have already become capital-intensive cyborgs plugged into global commodity circulation rather than symbionts connected with diverse commons regimes.

Modern Conflicts over Work and Energy

Wage labour became central to European conceptions of work only after a historical struggle full of "blood and fire" – encompassing, among other factors, the rise of Big-E Energy – lasting hundreds of years. Yet its very existence continues to depend on other kinds of work – the work of the home, the interactive work of maintaining commons, as well as, even more fundamentally, the work of what anthropologist David Graeber calls "baseline communism", or "the understanding that, unless people

consider themselves enemies, if the need is considered great enough, or the cost considered reasonable enough, the principle of 'from each according to their abilities, to each according to their needs' will be assumed to apply".[170] Effective movements for a transition away from fossil fuels will acknowledge the continuing reality of both wage labour and these other kinds of work – which are invariably obscured in the simplistic narratives of newspaper editorials or International Monetary Fund research reports.

Before the 1400s, when many commons still remained unappropriated, to become a waged worker in Europe meant that you were no longer free. Even in the 1600s, wage labour was still often regarded as a form of slavery – so much so that the British Levellers movement for popular sovereignty excluded wage workers from the franchise as being insufficiently "independent".[171] An uncoerced wage labour market did not exist until the 1700s, and even then only some workers were able to win wage contracts. What Europeans now usually refer to as "work" emerged only through slavery,[172] dispossession of land and other means of subsistence, disempowerment of women and their subjugation to the reproduction of the workforce, extermination of indigenous peoples, and unending efforts to divide and rule.

It was not until around 1600 that waged jobs were even included in the meaning of the English word "work". And only around 1750 did "work" become an abstract noun rather than a term referring to different concrete, countable, creative human deeds, tasks, efforts and duties. Only around the time of the steam engine, moreover, did the concept of commodifiable labour-power really come into its own: an abstract, ownable, saleable, homogeneous fluid that was standardized in units of time and that, according to the early 19th-century financial speculator David Ricardo, could even be treated as a measure of value. Yet other, conflicting meanings of "work" have continued to haunt the term down to the present day.

This multiplicity is perhaps clearer in non-European 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 *ngaan* also continues to signify a wide range of things that most contemporary Europeans call by other names – units of agricultural work, *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.

The same holds for the majority of the world's languages. As Ivan Illich noted in 1981:

> "For the last three decades, the Ministry for Language Development in Jakarta tried to impose the one term *bekerdja* in lieu of half a dozen others used to designate productive jobs. [President] Sukarno had considered this monopoly of one term a necessary step for creating a Malay working class. The language planners got some compliance from journalists and union leaders. But the people continue to refer to what they do with different terms for pleasurable, or degrading, or tiresome, or bureaucratic actions – whether they are paid or not."

Even Spanish, in its Latin American usages, continues to reflect resistance to the colonization of conceptions of livelihood by industrial or commodified versions of work:

> "All over Latin America, people find it easier to perform the paid task assigned to them than to grasp what the boss means by *trabajo*. For most toiling unemployed in Mexico, *desempleado* still means the unoccupied loafer on a well-paid job, not the unemployed whom the economist means by the term."[173]

Indeed, even the waged "work" most influenced by thermodynamic conceptions could never be done at all if not by people who resist, game and subvert it at every turn, changing its transformative ideal into an interactive reality. Just as money itself survives partly by being constantly decommodified,[174] the many-sidedness of "work" implied by concepts such as *ngaan* remains an integral part of US assembly lines and Wuhan computer factories, as sociologists as diverse as Michael Burawoy, Paul Willis, Gerd Spittler and Slavoj Zizek have argued.[175]

A condition for capital accumulation, this multiplicity is at the same time a root of business crisis when it surfaces in the guises of what George Caffentzis calls "refusals of capitalist work" (or, in the colourful language business might prefer, idleness, sloth, foot-dragging, "backward-bending labour curves", demand for shorter hours rather than more salary, and the like). Machines powered by Big-E Energy are often designed to neutralize such refusals, yet, as happened in the US in the 1960s and 1970s, fail to do so. It is no coincidence that the excuse made in the 1970s to certain groups of US workers on whom it was dawning that they would never achieve the place in the postwar white, male labour aristocracy that they had been implicitly promised was that an external "crisis" of not enough cheap (Big-E) Energy had broken out.

Energy Abstracted

The concept "energy" became abstract in much the same way and at more or less the same time as "work". In the late 1600s, mathematician Gottfried Leibniz had already posited a pre-energy mechanical force concept, *vis viva*, mass times velocity squared, as an abstract magnitude conserved throughout the universe, "like money when it is changed".[176] But it was only in the 1700s and 1800s that mechanical force and various other phenomena started to be commensurated with each other, bit by bit, in a diversity of practical and theoretical ways under an emerging energy concept: motion with heat, electricity, magnetism, light and so forth (*see* above).

As with "work", this trend has always contained and concealed its own nemesis. Big-E Energy has never represented anything other than a set of struggles and contradictions. Its traces will affect everything that comes after, but are themselves subject to being wrought into completely different shapes.

To take a simple example, one characteristic of abstract, Big-E Energy is that there can never be enough of it. It is scarce in principle. Inside this Energy, however, remain the plural, vernacular, little-e "energies" out of which it was made. These are largely invisible to official eyes,

partly because there could be no generic name for them before Big-E Energy itself came along to oppose and assimilate them (*see* Box: "Oppositional Concepts and Their Double Edges"). Particular to specific household, commoning and "baseline communist" practices, these "energies" are in constant tension with Big-E Energy in that they tend to be self-limiting. There may sometimes be a dearth of them, 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 the hundreds of millions of people who rely predominantly on them.

Take, for example, the attitude of a Southeast Asian villager using dead wood from a local common woodland in order to cook rice. She is unlikely to regard herself as using an abstract "Energy". For her, it would be crazy, antisocial and disrespectful to use more wood than was just enough to cook the meal. Yet the wood is not in any way scarce, provided that the local woodland is treated and conserved by the community as a "dead wood commons". If the villager can be induced to talk about "energy" at all, it is likely that it will be in the sense of something that promotes subsistence and well-being – heat for cooking, light for schoolchildren to read books by, possibly the odd refrigerator or TV – not an abstract potion limitless applications of which will make everyone richer and richer. In regions like Manggerai on the Indonesian island of Flores, fossil energy use is very low, but "energy" is simply not a very interesting issue for discussion compared to, say, mining conflicts, because there is usually felt to be enough.

Contrast the Southeast Asian villager with a government energy planner. For the planner, energy is abstract. It might be coal, wood, hydroelectric, nuclear; it might be used by a steel factory, a hospital, a bus fleet. From the planner's point of view, there can never be enough of it, because its purpose – economic growth – is also abstract, as well as being in principle unlimited. This energy will *always* be scarce.

These two realities coexist. They interact with each other constantly. The planner's reality has always been utterly dependent on the villager's. Nor can the two realities be identified with the "past" and the "present", nor with "no change" and "change". Nor are they "different pathways" or "alternative trajectories" to each other. The villager's little-e "energies" are no more an "alternative energy model" to be offered to the planner than the planner's Big-E Energy is an "alternative energy model" to be offered to the villager.

For the planner, the villager's woodland will always represent, roughly speaking, either raw material to be transformed into Big-E Energy or an obstacle to be cleared out of the way so that a hydroelectric dam, oil refinery or wind farm can be erected. When the economy that the planner seeks to manage faces a crisis (and he himself faces possible redundancy), he may temporarily "discover" the virtues of the common woodland as a cheap "subsidy" that helps keep the villager's labour on ice until a recovery becomes possible. This will do nothing more, however, than conceal the underlying contradiction for a time.[177]

For the villager, similarly, the planner's Big-E Energy will always amount, roughly speaking, to a threat of extreme violence. In practice, the hydroelectric dam, oil refinery or wind farm that the

planner proposes to meet his abstract, hypothetical "energy demand" signifies privatization, fences, rifle butts, lawyers, migration, forced unemployment or modernized poverty – generally speaking, denial of the implicit "right to live" of both the villager and the woodland.[178] If the threat is fulfilled, the villager, like all survivors, will try to make do. Just as the planner is prepared to improvise in the face of his crisis by treating the villager's woodland as an "emergency backup" for a system powered by Big-E Energy, so the villager will improvise in the face of hers by parasitizing the planner's Big-E Energy for the maintenance of her own framework of little-e energies. If she is able to find a new home, she may, for example, steal or bargain for a modicum of grid electricity to keep her family going, or perhaps find a shifting livelihood as a street vendor with a bottled gas stove in the interstices of the fossil fuel transport network.[179]

Similar conflicted relationships arise between Big-E Energy and many practices of indigenous peoples that are also sometimes translated under the rubric of "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 across the planet.

No Green Energy

Another way of putting the point is to say that the idea of a "green" Big-E Energy is, in some sense, a contradiction in terms. The Southeast Asian villager cannot offer an "energy alternative" to the state or corporate planner in terms that either party could ultimately find itself at peace with. An "Energy" that derives from fossil capital has an internal dynamic ultimately opposed to climatic stability and the maintenance of livable surroundings. This is so no matter how many efforts are made to "defossilize" it while keeping its abstract, accumulable character, as Jean Robert points out:

> "We are no less enslaved whether the car runs on coal or hydrogen; whether the lightbulb shines because of water or wind. Neither the technocrat nor the ecocrat can lessen man's slavishness as long as both cannot see the distinctions erased by energy. It would be a political act to stop looking at the wonderland that appears through 'energy' glasses. Under the shield of such radical energetics, an economy in the true sense of 'administration of one's own house' could flourish again … freed from the energy-entropy form of the obsession with scarcity."[180]

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

various indigenous "energies". But Big-E Energy will always have an oppositional dynamic. This is why talk of "the right to development" or "greenhouse development rights" grates so harshly on the ears of many who have persistently been on the wrong end of "development" initiatives. It is a peculiar kind of "right" that can be enjoyed by some only if others cannot enjoy it.

Remembering the Back Story

"Nineteenth-century England," writes anthropologist Alf Hornborg, "needed a usable theory of capital accumulation that attributed to industrial capital a generative force of its own and explained why Britain was getting so rich." The stockbroker David Ricardo, among many others, helped spell out out this theory in economic treatises such as *On the Principles of Political Economy and Taxation* (1817). These then took their place among a larger set of attractive and superficially plausible "front stories" about capital accumulation generally.

In industrialized societies, most everyone knows at least some of these stories by heart: Market Exchange is Equal Exchange, Machines Create Wealth, Growth Will Eventually Make Everyone's Life Secure, Compound Interest is a Law of Nature, Riches are the Reward for Self-Denial, Energy is a Tool, More Energy Means Progress, Correct Prices Will Ensure Sustainability, and so on. They are the collective creation of more than two centuries of proselytizing by philosophers, economists, historians and scientists, as well as political leaders and bureaucrats and technocrats of both left and right political persuasions.

It is only to be expected that such "front stories" will be told, retold, and constantly rewritten and added to. They are crucial to the functioning of all industrial societies. But activists seeking a transition to saner energy practices cannot afford to avert their gaze from the "back stories" that lie behind them. They need to remember why machines cannot create new value by themselves; when what is represented as reciprocal exchange via the ideology of "market price" signifies appropriation and inequality; how growth increases the insecurity of the majority; and so forth.

As much as anything else, they need to remember the violent back story of thermodynamic, Big-E Energy in all its complexity. This a tale featuring not only the enclosure of human lives and the land they depend on, but also the maintenance and continual re-emergence of practices of coping, accommodation and resistance. Thanks to Big-E Energy itself, many such practices can now, anachronistically, be referred to using the "oppositional concept" of little-e "energies" (*see* Box: "Oppositional Concepts and Their Double Edges"). Figure 1 depicted earlier provides one possible rough "preview" of such a back story.

Oppositional Concepts and Their Double Edges

It is part of the nature of what this report calls "little-e energies" that there has never been a standard term to describe them. Here, they have necessarily been defined in opposition to Big-E Energy, largely as being what Big-E Energy is not. Which is another way of saying that the term "little-e energies" begins to have a political use only toward the right-hand segment of the arrow on page 7.

The term "little-e energies" accordingly carries risks of erecting unwholesome dualisms. To use it to describe a pre-19th century reality before fire, animal exertion, magnetism and wind were commensurated is to be as anachronistic as it would be to apply the contemporary Big-E Energy concept to the same period. Parasitic on Big-E Energy, the phrase "little-e energies" is by itself a poor tool for imagining either the past or future of energy, work and finance.

Yet among urban-based Europeans, it is often hard to grasp the political and scientific biases in the concept of Big-E Energy without attempting at least a rough contrast between the energy practices that we know best and other practices that have generally had no generic name, and to which Big-E Energy opposes itself. Such a contrast may be a starting point toward a wider perspective. To modify a concept used by feminist biologist Donna Haraway, "little-e energies" is a reactive or "oppositional" term that "would simply bewilder anyone not preoccupied with the machines and consciousness of late capitalism".

A close analogy is the term "commons". Like "little-e energies", "commons" tends to be a term of political art and not of self-description. Most commons have never gone by that name. For most of history there was no need for such a generic term. The differences between the practices referred to – estover, *minga*, *ejidos*, locally-maintained irrigation systems, communal fields and pastures, traditions of gleaning or gathering or turf-cutting or setting aside "pin money" or seeds, sharing software development, or even just maintaining considerate silence after dark – were more important. Even today, the vast majority of commoners would not recognize themselves in the word or in any of its translations. When they do – as, for instance, when Thai villagers and NGOs come to use the rather new, abstract vocabulary *khong suan ruam* (common thing) or *paa chum chon* (community forest) to designate a multitude of diverse agricultural, religious, political practices – it is usually for purposes of building movement alliances in new contexts of struggle. It was mainly in reaction to enclosure, the rise of industrial society, and the voraciousness of a business sector eager for wage labour that resistance reached for a generic term that unavoidably took on much of the abstract colouration of what was being contended with. In the mouths of many intellectuals today, "commons" is a sort of anti-commodity or commodity foundation, a negative image of resources, a dark twin of private property (property without the "private"), an invitation to twee sentiment rather than a modern, multiple, internally diverse presence in its own right.

Sometimes, rather than becoming an opposite pole for commodities, commons begin to be conflated with them. It is a staple of development discourse that commons are pre-commodities, failed commodities, or an inadequate or incomplete type of property. There is no shortage of those who, reacting to such insults, attempt a highly-formalized defence of commons using a capitalist idiom; to show that commons are defensible as the best kind of capitalist "resource management". Not that there is never any basis for such excursions: indeed, many commons come to owe their form to their role supporting or defending profit-centred activities.

Yet if the concept of commons partakes of reaction and cooptation, it can also constitute an affirmation, rallying point, and promise of liberation. In Latin America, for instance, "commons" has been, until very recently, a somewhat alien bit of jargon, less familiar than in Europe or Asia. Yet by 2012, in the popular forum on the fringes of the Rio + 20 UN Conference on Environment and Development, "commons" was one concept that provided a rhetorical fulcrum for efforts to unify Latin American with Asian and African social movements against proposals for a new Green Economy issuing from the likes of the World Bank and the International Union for the Conservation of Nature.

Sources:

Donna Haraway, *Simians, Cyborgs and Women: The Reinvention of Nature, Free Association*, London, 1991, pp.155-56;

George Caffentzis, "A Tale of Two Conferences: Globalization, the Crisis of Neoliberalism, and the Question of the Commons", 2004, http://www.commoner.org.uk/wp-content/uploads/2010/12/caffentzis_a-tale-of-two-conferences.pdf.

As a whole, the political left has a poor record in seeing arrows like Figure 1 steadily and seeing them whole. It has found it hard to avoid fetishizing thermodynamic energy and overlooking its anti-commons political bias and foundation in crisis. Instead, it has tended to accept uncritically the "front story" that straightforwardly identifies Big-E Energy availability with the advance of "civilization", inclusion and democracy. This was a narrative advanced in the 19th and 20th centuries not only by figures like philosopher Herbert Spencer, biologist Patrick Geddes and chemist Wilhelm Ostwald, but also by Vladimir Lenin in the Soviet Union and, in the US, New Deal leaders, author Lewis Mumford, and the technocratic movement. It continues to be told today.

Thus, for example, in the mid-20th century US, the story was repeated of (white, male) workers who had been able to extract so many concessions from business that they had finally escaped into a new middle class of relative comfort and security – one that some day, God willing, would be available to everyone thanks to energetic advances. But the tale failed to include a description of many of the things that had made the purported escape possible and would prevent others from making it: the unwaged character of the housework and child-raising that supported most workers, the continuing severe exploitation of people of other races, conflicts waged over oil, and so on. More generally, such front stories hid back stories of encroachment on and undermining of commons of many kinds in both South and North. In rural areas these prominently included the destruction, by extraction and industrial projects, of terrestrial and aquatic ecosystems as well as many self-provisioning capacities. In more urbanized areas they included the undermining of commons of mobility, time and care described by writers such as Ivan Illich, Kate Pickett and Richard Wilkinson.[181] It was seldom mentioned, for example, that each kilometre of motorway built for the cyborg consumer reduced the ability of ordinary people to navigate spaces outside the office-factory-suburbia circuit; or that increases in overall cyborg consumption, when accompanied by increases in inequality, reduced the capacity of a society to sustain overall health and well-being. Yet such front stories continue to dominate a great deal of historical and political thinking about energy, including naïve perspectives that identify "energy justice" with an impossible universal and equitable distribution of Big-E Energy.

This section has tried to explore a few aspects of the history of energy politics that are likely to be useful to understand when undertaking effective work toward an energy transition. It aims to pave the way for the last section, which will sketch some suggestions for strategy that both acknowledge the reality of arrows like that pictured in Figure 1, yet have potential to bend its trajectory in new directions. First, however, a closer look must be taken at the links between thermodynamic or Big-E Energy and state and corporate financial institutions, including investment banks, private equity firms, mutual funds, development banks, hedge funds, sovereign wealth funds, master limited partnerships, climate funds, oil companies and real estate investment trusts. This is the job of the next section, which will stress that finance, like energy, is not a "thing" – a pot of money or an ATM machine – but rather a complex historical and political process, a trajectory and a continuing social struggle.

The Energy of Finance and the Finance of Energy

Like energy, finance has its own store of front stories and back stories. While the front stories tell of the evolution of increasingly sophisticated ways of safely managing flows of money, pricing risk and increasing the value of personal savings, the back stories are histories of many-stranded and generally violent struggles that, writ large, have pit (and continue to pit) those who would use finance as a means of accumulating wealth against those who would harness finance to support social relations and activities founded on the responsibility of all for each other's welfare. Behind that narrative are other back stories of conflicts within and among numerous social movements over different strategies of accumulation and, conversely, over different means of opposing such strategies. Compromises abound (they are unavoidable), yet never entirely settle the inextricably-interwoven and constantly-erupting conflicts between finance-as-exploitation and finance-as-commoning. Each such compromise merely lays the ground for the next conflict. There is no end of history.

Activists on all sides duck and weave their way around obstacles, making use of what is at hand in attempts (some more successful than others) to construct the social and political relationships that might block or otherwise unsettle the other sides' moves and assist in "creating the world that they want". Strategies and tactics are filched and reworked for purposes that are often the opposite of those for which they were first devised. The first fund set up specifically to invest in infrastructure, for example, was created not by venture capitalists out to make extra-high "alpha" returns, but by trade unionists eager to direct private investment to companies with progressive labour relations,[182] while microfinance, which originated in many cases out of struggles to redress power imbalances in access to finance, has now become a route through which big banks and private equity firms gain access to the savings of poorer people.

None of this is really a surprise. Modern finance is not simply an ATM that provides cash, whether for windmills or coal-fired power stations or new Ipads. It is not a "thing" but a constantly changing set of relationships and social formations that are never entirely capitalist nor entirely of the commons, but rather aligned along a spectrum that is more or less capitalist and more or less commoning. Its trajectory is not fixed for all time: whether finance serves to accumulate wealth for the few or, conversely, to build mutuality is contingent on the relative organizing power of different social movements and the outcome of the struggles among them. For finance is never just coins and bills: it is a bundle of political, economic and social relationships whose internal conflicts create its direction of travel.

Recognizing this may help in evolving strategies beyond those that approach "energy finance" on the assumption that there are forms of finance that float free, on the one hand, from capitalism as "an institutionalized social

order"[183] and, on the other, from the commons. No such spaces exist. Many millions of people around the world (perhaps even the majority) certainly rely on means of managing flows of money, such as tontines,[184] savers clubs, friendly societies and other collectively-organized institutions, *without* seeking profit. But while they build upon (and build) social relationships that operate on a logic that differs from, and poses a potential challenge to, finance-as-accumulation, they are nonetheless deeply entangled with capitalist forms of profit-seeking. The money deposited in a not-for-profit community bank, for instance, will in most cases come from company wages. The contrary is also true: capital cannot escape the commons. Indeed, historically, it has always depended on non-commodified forms of care (for instance, women's work in the home) to sustain its workforce and has (warily) relied, particularly in times of hardship and economic crisis, on workers being able to fall back on the social networks sustained by not-for-profit forms of finance and other forms of collective provisioning.[185] In effect, the trajectory of capital is not separate from the trajectory of commoning: the opposing components rub up against and confront each other, reacting to create the overall direction of travel. The questions for progressive activists are how best to reinforce the role that commoning *already* plays in finance and how to take sides with certain vectors within the joint trajectory and against others.

Out of the many back stories of finance, three examples may help to tease out the historical connections between energy and finance and indicate how those connections (and the struggles surrounding them) have shaped, and continue to shape, the trajectory of finance today. Such back stories may help activists set their own discussions around financing an energy transition into a broader perspective that refuses to reduce finance to inert pots of currency but instead insists on approaching it as politics. The first story involves the intimate links between modern finance and Big-E Energy – and describes how the political, social and bureaucratic challenges generated by the need to find funds to finance industrial expansion has spawned many of the corporate and financial institutions, instruments and practices that dominate finance today. The institutional forms that have emerged to pool and direct capital to the most profitable investments have also transformed capital itself, making it more mobile and intensifying its exploitative pressures on workers and the environment.

A second story centres on efforts by capital to free itself from the constraints of geographically-specific local commons and struggles to keep finance tethered. A third sketches the impacts of financialization on the energy sector and places it in the broader context of the current financial crisis.

Back Story 1: Big-E Energy, Finance and the Transformation of Capital

The history of modern finance is intimately intertwined with that of thermodynamic Energy. Indeed, it could not have been otherwise. Big-E Energy-organized economic activity survives only because sufficient surplus can be directed to building, maintaining, refurbishing and expanding the infrastructure of oil wells, coal mines, electricity grids, coal-fired power stations, wind farms and nuclear plants that fuel such activity and permit its constant growth.

The financial instruments that business and banks have cobbled together to raise funds for oil, gas and coal exploration are many and varied. For example, project finance (until recently the most widely used form of debt finance) began in the 1930s when a Dallas bank extended a nonrecourse loan to an oil and gas company seeking an off-balance sheet form of finance that would enable it to develop new fields without placing its core assets at risk.[186] Oil and gas interests have since worked with financiers to create hybrid, derivative-based project finance deals in which the expected future income from a project is securititized and pre-sold to investors, a form of finance used to fund oil and gas expansion in Angola, Qatar and Mexico (and also by Enron to disguise its losses).[187] The very first commodity index fund, devised in the early 1990s by investment bank Goldman Sachs (a major financier of the oil and gas industry, raising $400 billion for energy companies and projects between 2003 and 2008) also involved oil and gas. The idea was to create a tool that would provide "clients that wanted to go drill oil wells but [who] needed some predictability of the price of oil" with a market for their oil at guaranteed prices.[188] Similarly, the first credit default swap (an insurance bet of the kind that led to the collapse of insurance giant AIG in 2008) was engineered in 1994 to enable merchant bank JP Morgan to make a $4.8 billion loan to oil giant Exxon to cover Exxon's potential liabilities from the Exxon Valdez oil spill in Alaska, without requiring JP Morgan to set aside capital reserves against the loan.[189] Energy firms were also behind the first ever weather-derivative trade, transacted in 1996 between energy trader Aquila Energy and utility company Consolidated Edison (ConEd). Weather trading is now a multi-billion dollar industry, with the energy sector making up over 70 per cent of end users;[190] the most active participants are reported to be "power marketers/utilities, hedge funds and banks".[191]

But finance's entangled relationship with thermodynamic or Big-E energy goes deeper than clever financial engineering. Historically, the voracious appetite of Big-E Energy for funds has played a key role in transforming capital, rendering it more mobile, increasing its competitive pressures and encouraging companies to squeeze more profit from the work of labour and nature. The rise of the joint stock company, in which the ownership of companies is separated from the management of production, is a case in point (*see* Box: "From Partnerships to Joint Stocks to MLPs").

Without joint stocks, Karl Marx commented in 1867, "the world would still be without railways" – it would simply have taken too long for any owner-capitalist acting alone to accumulate capital sufficient for the construction of a railway. By contrast, the centralization of capital mobilization through the joint stock form enabled the funds to be raised "in the twinkling of an eye". But, as Marx recognized, joint stocks did more than extend the pool of available finance for industrial expansion. Describing joint stocks as an association not of individuals "but of capitals",[192] he warned that they represented the "abolition of capital as private property".[193] By separating ownership from management and by raising capital from the general public (albeit the moneyed public), they gave the appearance of being "social enterprises as distinct from private ones".[194] The identity of the owners was hidden: surplus was extracted not by identifiable owner-capitalists but by anonymous "capital". As such, Marx argued, joint stock companies represented a significant extension of capitalist relations into society.[195]

From Partnerships to Joint Stocks to Partnerships Again: The Unleashing of Capital

Just as fossil fuels made it possible for manufacturers to de-link energy use from specific, context-bound energy sources (for example, rural rivers and streams) and extract greater surplus by concentrating workers and production in large, urban factories, so the expansion of finance-as-exploitation required the extrication of capital from the constraints of locally-specific webs of capital mobilization.

At the outset of Britain's industrial revolution in the 18th century, capital was still relatively immobile. In the main, companies took the legal form of partnerships, each partner committing his or her capital for the duration of their partnership, each being liable should the enterprise fail, and each having decision-making rights in the management of the company.

But from early 19th century, a number of pressures combined to bring about a shift – gradual in some sectors, more rapid in others – in the predominant legal form that companies took and the accompanying means through which they mobilised capital.

One driver was the increasingly large amounts of money needed to expand industry. Railways, vital to opening up new markets and increasing the speed, volume and regularity of distribution, sucked up capital. Mining costs were also rising, as easily-exploitable surface seams of coal were exhausted, necessitating deeper pits and raising costs by as much as a hundred-fold. The costs of mill building also increased sharply with the shift to steam-powered, urban-based factories, as steam-powered mills cost three to four times more than water-powered mills.

The problem for business was not that there were insufficient savings in Britain to provide the extra investment, but that they were geographically-dispersed and that there were institutional barriers to obtaining them (not least the relatively-undeveloped state of stock markets and regional banks).

The "solution" (opposed by many sectors of society, including businesses that had not yet industrialised) was a revival of the joint stock company, a form of corporate ownership that had first emerged in Holland in the 17th century as a way of financing risky overseas trades, but that had been strictly regulated in Britain following the South Sea Bubble in 1720. Under pressure from industry and would-be investors, the restrictions on forming joint stocks were eased in 1825 and all but removed twenty years later.

A key feature of joint stocks was that ownership was separated from management. Unlike in partnerships, investors (although owners) have only a token say in the day-to-day operations of a company. Buying shares gets them only the contractual right to a share of the profits proportional to their investment. Consequently, capital could now compete as companies, less beholden to the wishes of individual investors. Investor's losses were also limited to the nominal value of their paid-in capital, rather than jointly shared.

Moreover, instead of having to commit their money for prolonged periods, investors were free to sell their shares at any time to anyone who would buy them. Investment was thus significantly liberated from the personal relationships and locked-in commitments that limited the size of the capital pool available to partnerships. Shareholders could now shift between investments with relative ease: one day, they might be "in" railroads, another "in" knitting mills, the determinant being the rate of return on their investment.

Joint stock companies enabled the pooling of capital necessary to construct the infrastructure to expand commerce and industry in Britain and elsewhere in the late 18th and 19th centuries. Joint stocks financed most of the canals in Britain and were the force behind the expansion of the railways, not only in Britain but also in other countries, notably Germany and the United States. As Alfred Chandler records in his history of business in the US, railway companies were the first private enterprises in the US to acquire large amounts of capital from outside their own immediate localities, a development that would not have been possible without the joint stocks mechanism.

But even as the number of joint stock companies rose, significant voices within established elites in both Britain and the US opposed the development. In 1840, *The Times* railed against the separation of ownership from responsibility and warned of the threat to society when "money, the mere amount and value of the shares standing in the name of each" becomes "the sole bond of connection between . . . proprietors".

But, in the long term, such opposition proved ineffectual. By the turn of the 19th century, the joint stock company and capital markets were well on

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their way to becoming the main vehicles through which corporations operated and raised finance. In 1911, Republican educator Nicholas Murray Butler, President of Columbia University, hailed the joint stock corporation "the greatest single discovery of modern times", more important even than steam and electricity. The histories of the two are in fact inseparable.

Back to Partnership

Today, businesses are again mutating as investors seek to create new institutional structures that will yield higher returns. To avoid the corporate governance and tax rules that apply to the traditional limited-liability joint stock company, firms are evolving into new forms, massively increasing their returns to a select band of investors.

The preferred vehicles are variants of a structure that was first imported into the US from Panama in the mid-1970s, the Limited Liability Company (LLC). LLCs provide the tax treatment of a partnership (thus avoiding corporation tax) yet also protect the partners from individual liability for company debts and litigation.

Master Limited Partnerships (MLPs), the incarnation most favoured within the oil and gas industry, have been engineered to bring still other benefits. Listed on the stock exchange, they combine the tax benefits of an LLC with the liquidity of publicly-traded securities. But their key feature (a condition of their exemption from corporation tax) is that they function as "pass-through" companies: whatever income they receive during a given year is paid out. Nothing is retained.

As a result, many of the rules that protect shareholders in joint stock companies do not apply, and shareholders (known as unit holders) have very limited rights. MLP managers are thus freed from having to respond to shareholder resolutions over directors' pay, human rights, environmental impacts or labour practices. Instead, as *The Economist* reports, the relationship between owners and managers is reduced to a single critical factor: "the ability of these sorts of entities to pay out large distributions". Capital is freer to do its job as capital, less encumbered by the interference of shareholders or greenies.

With MLPs and other pass-through companies (other forms include Business Development Corporations and Real Estate Investment Trusts) returning dividends that are typically double or triple the market average (a function of their exemption from corporation tax), investors are voting with their feet. In 2012, pass-throughs accounted for 9 per cent of US listed companies but attracted 28 per cent of the equity raised; and recent research suggests that the LLC has now replaced the corporation as the most commonly formed new business entity in the United States.

The trajectory is thus towards an increasingly close alignment between the interests of capital and piratical managers in search of alpha returns, with earnings being used to increase yield rather than being retained for investment in improved productivity, technological innovation or, God forbid, higher wages for workers. It is also a potential body blow to strategies of reform through using shareholder power to enforce corporate social responsibility.

Sources:

Alfred Chandler, *The Visible Hand: The Managerial Revolution in American Business*, Harvard University Press, Boston, 1978;

"The New American Capitalism: The Rise of the Distorporation", *The Economist*, 26 October 2013, http://www.economist.com/news/briefing/21588379-mutation-way-companies-are-financed-and-managed-will-change-distribution;

Jonathan Barron Baskin and Paul J. Miranti Jr, *A History of Corporate Finance*, Cambridge University Press, Cambridge, 1997;

Dick Bryan and Michael Rafferty, *Capitalism with Derivatives: A Political Economy of Financial Derivatives*, Capital and Class, Palgrave Macmillan, 2006;

Rodney Chrisman, "LLCs Are the New King of the Hill: An Empirical Study of the Number of New LLCs, Corporations and LPs formed in the United States between 2004-2007 and How LLCs Were Taxed for Tax Years 2002-2006", *Fordham Journal of Corporate and Financial Law*, Vol. XV, April 2010, p.459-489, http://works.bepress.com/cgi/viewcontent.cgi?article=1007&context=rodney_chrismn;

P. L. Cottrell, *Industrial Finance, 1830-1914: The Finance and Organization of the English Manufacturing Industry*, Routledge, 2006;

Muzaffer Eroglu, *Multinational Enterprises and Tort Liabilities: An Interdisciplinary and Comparative Examination*, Edward Elgar, Cheltenham, UK, 2008;

Anne Laurence, Josephine Maltby, Janette Rutterford, "Introduction", *in* Anne Laurence, Josephine Maltby, Janette Rutterford (eds), *Women and Their Money 1700-1950*, Routledge, 2008;

Karl Marx, "The General Law of Capitalist Accumulation", *Capital*, Volume 1, 1867, https://www.marxists.org/archive/marx/works/1867-c1/ch25.htm;

Michael Postan, "Recent Trends in the accumulation of capital", *The Economic History Review*, October 1935;

Douglas W, Rae, "Rise of the Joint Stock Corporation", Yale lecture series: "Capitalism: Success, Crisis and Reform", Yale University, http://www.youtube.com/watch?v=yw7xkPeyelY;

Nick Robbins, *The Corporation that Changed the World: How the East India Company Shaped the Modern Multinational*, Pluto, London, 2006;

James Taylor, *Creating Capitalism: Joint-stock Enterprise in British Politics and Culture, 1800-1870*, Royal Historical Society/The Boydell Press, 2006.

Today, joint stock companies dominate the corporate world, sucking in equity finance from not just the moneyed public but also from workers themselves through their pension funds, insurance policies, bank deposits and the like. With over US$10 trillion of workers' pensions now invested in the world's capital markets,[196] the words of American lawyer and anti-monopoly activist Louis Brandeis, written in 1914, remain relevant: "They control the people through the peoples' own money . . . The fetters which bind the people are forged from the people's own gold."[197]

As a result of resistance to private ownership of energy generation and distribution, the role of joint stocks in raising energy finance diminished in many countries during much of the 20th century as states took railways, energy utilities and other sectors of industry into public ownership. This is turn led to the emergence of other forms of pooling to supply the finance for infrastructure development. The creation of multilateral development banks, such as the World Bank, is a case in point: indeed, without them, it is doubtful whether the roads, pipelines, electricity grids and other infrastructure could have been put in place to enable the worldwide expansion of Big-E Energy on the scale that has occurred since the Second World War. But capital has pushed back against state ownership, and infrastructure financing is again returning to the capital markets. In addition, pricing of energy has largely been deregulated, with prices being set through markets rather than by the state.

One consequence of both these trends has been the increased used of derivatives (a form of finance that, like joint stocks, has been subject to periodic bans throughout history due to its tendency to encourage speculation and financial instability) by companies and financial institutions, nominally as a means of "pricing risk" but also as part of a wider project of transforming uncertainty into a commodity (*see* Box: "Enmeshed in Derivatives").[198]

The widespread use of derivatives is now creating what political economists Dick Bryan and Michael Rafferty have termed capital's "third degree of separation".[199] The first degree (following Marx) involved the separation of humans from their means of livelihood through the commodification of labour "so that the owner controls production and capital competes as firms". With "joint stock/limited liability", a further separation took place, between company ownership and the management of production. The third degree is now underway, in which "capital ownership is separated from company ownership and capital competes as itself".

A defining feature of derivatives is that they separate the ownership of capital from the assets that underlie it. Consider the difference between the owner of shares in a company and the owner of an "option" on shares in a company. The shareowner has real ownership of part of the company, but the derivative owner has no such ownership rights: instead, the option gives its owner the right, but not the obligation, to buy or sell shares in that company at a particular time and at a particular price. More sophisticated versions of the derivative may link that right to, say, a movement up or down in interest rates. In effect, the derivative gives its owner exposure to the *performance* of a particular quantifiable attribute of the underlying asset, in this case the future price of a share and (in the more sophisticated version) the share's price relative to future interest rates. Only the attribute, not the underlying asset, is traded and

Enmeshed in Derivatives

Derivatives are not new: they date back centuries, although their use has frequently led to their being banned. However, when permitted, they have never been used as widely or in the volumes that they are used today.

One proximate cause, at least within the energy sector, dates back to the 1980s. Prior to that, energy in the form of gas, coal and electricity was largely provided either by state monopolies at prices determined by the state with investment centrally planned by government bureaucracies, or by private monopolies subject to government oversight and regulation to protect users from excessive charges. But such systems of price control and price support were swept away during the 1980s as governments, North and South, embraced (or were forced by the International Money Fund to adopt) neoliberal market-driven approaches to energy generation and distribution. In their place, ambitious programmes have been put in place to construct wholesale markets between generators and retail suppliers where the price of energy is supposed to reflect supply and demand rather than government regulation.

In the case of oil, this "move to the market" began a decade earlier, when national oil companies in producing countries began to wrestle control of oil production from the hands of Western oil companies (*see* Box: "Never Let a Crisis Go to Waste"). The move broke the integrated control of production, refining, distribution and retail that the western oil companies had exercised and through which they had transferred their price risk from upstream production and refining to downstream distribution and retail. Instead of producing their own oil, they now had to buy oil from the national oil companies; and instead of the oil companies setting the price of oil, it was set (at least for a short period) by Organisation of Petroleum Exporting Countries (OPEC).

The bulk of the oil entering world markets was no longer purchased through cosy deals within and between oil companies, but by traders buying and selling at prices set by OPEC. To reduce their exposure to increased price volatility, the oil companies entered into long-term contracts with the oil producers; but, when OPEC tripled the price of oil in the late 1970s, the oil majors found they were getting locked into prices that were higher than those on the spot market, where prices were lower in part because of the increased availability of non-OPEC oil, whose production, by 1980, had overtaken that of OPEC. Spot market trading took off: by the mid-to-late 1980s, it accounted for 40-50 per cent of international oil trades, as against 5-8 per cent in the early 1970s.

Increased price volatility brought increased risk, and increased risk brought increased opportunity for profit. Wall Street and the City of London were quick to spot the potential, rapidly moving to develop derivative-based instruments that would transform "price risk management" in the energy sector (and others) into a tradeable commodity.

It was no easy task. Traders recall "getting nowhere" to begin with, due in part to a lack of liquidity in the futures market beyond three months and in part to a lack of interest or understanding among market players. (*Energy Risk* magazine records the reaction of Shell executives to a derivatives sales pitch from Morgan Stanley as being one of "bafflement and confusion".) But perseverance eventually paid off. In 1986, some 10 years after the first OPEC oil shock, Lawrence Kitchen, a trading manager at energy trader Koch Industries, took a leaf from the currency and interest rate markets, where instruments known as swaps were already widely used, and traded the first ever oil swap – through Chase Manhattan bank – with the airline Cathay Pacific. Under the deal, spot price payments were swapped for fixed rate payments, enabling Cathay to hedge against a rise in jet fuel prices.

The range of instruments employed by companies has expanded massively since Kitchen's first oil swap. A bewildering array of oddly-named products – from swaptions to caps, floors, lookbacks, knockouts, Double Asians, swings and collars – are now available to market participants. Moreover, the risks that are now "managed" through derivatives have also expanded, criss-crossing sectors. Oil companies, for example, not only use specialised energy derivatives (such as oil swaps) to adjust their exposure to fluctuations in the prices of crude oil, refined products, natural gas, power and coal; they also make use of freight rate derivatives (to adjust their exposure to freight-rate fluctuations); and interest rate and foreign exchange rate derivatives as part of their financing and cash management activities. Derivatives are also used to maximize debt for acquisition or project financing. Indeed, the daily activities of the vast majority of commercial power producers and end users in the North (and many in the

South) are now enmeshed in derivatives of one sort or another. This applies as much to not-for-profit providers as to for-profit ones, and to fossil-fuel generators as to renewable generators. In the US, for example, the 930 not-for-profit, member-owned energy co-operatives that make up the National Rural Electric Cooperative Association (the largest electric utility network in the nation, servicing over 42 million customers in 47 states and owning and maintaining 42 per cent of the US electric distribution system) are major users of interest rate and currency swaps, both for price hedging and to increase the loan options available to their members. The use of derivatives is also widespread among wind, solar and other renewable energy providers in Western Europe, North America and Australia, according to a 2011 survey by the Economist Intelligence Unit, which found that almost half of respondents used derivatives to transfer financial risk.

Many predict that derivative use will increase in the renewables sector, partly because the removal of many subsidies increases the risks, and partly because a range of new derivative products tailored to the industry (notably weather derivatives) are coming onto the market. Within the energy finance community, many practitioners are eagerly pushing for "solar securitization", whereby the contracted revenue streams from a group of solar projects are bundled together and sold as a tradable, interest-bearing security.

Commentators see such derivative-based securitisation as the best way for the solar industry to secure "access to a much broader pool of investors, ultimately helping to cut the long-term cost of capital, reduce levelized energy costs, and enhance liquidity in the solar project market".

In Britain, meanwhile, *all* renewables are now locked in to the derivatives market whether they like it or not, since the government has replaced Feed-in Tariffs, which guarantee prices to producers, by derivative-based "contracts for difference" (CfDs), under which producers get a guaranteed price provided they can reach a power purchasing agreement with a distributor but must pay the difference to the government where the spot price exceeds the guaranteed price. One consequence, as David Toke of the University of Birmingham argues, is that smaller generators will be squeezed out of the market, both by the requirement to post large sums of collateral to cover possible "imbalances penalties" and because they will be unable to afford to employ the trading arm necessary to implement CfDs and put in place the necessary trading agreements. Price support in the form of a government-set guaranteed feed-in tariff has thus been transformed into a mechanism for profit-making and exclusion.

Sources:

Energy Charter Secretariat, Putting a Price on Energy: International Pricing Mechanisms for Oil and Gas, Energy Charter Secretariat, 2007;

Glenn English, "Testimony of the Honorable Glenn English, CEO National Rural Electric Cooperative Association Before the United States Senate Committee on Agriculture, November 18, 2009", *in* American Gas Association, American Exploration & Production Council, American Public Gas Association, American Public Power Association, America's Natural Gas Alliance, Edison Electric Institute, Electric Power Supply Association, Independent Petroleum Association of America, National Rural Electric Cooperative Association, Natural Gas Supply Association, PJM Interconnection LLC, OTC Derivatives Reform: *Energy Sector Impacts*, January 2010, http://www.ngsa.org/download/issues/OTC_Derivatives_Reform_Packet.pdf;

Paolo Davide Farah and Elena Cima, "Energy Trade and the WTO: Implications for Renewable Energy and the OPEC Cartel", *Journal of International Economic Law*, Volume 16, Issue 3, September 2013;

A. Stephen Kennedy, "Oil and Gas Derivatives – Why Use Them and How to Avoid Margin Calls", *Oil and Gas Financial Journal*, 1 October 2005, http://www.ogfj.com/articles/print/volume-2/issue-8/capital-perspectives/oil-and-gas-derivatives-why-use-them-and-how-to-avoid-margin-calls.html;

Kazumasa Osaki, "End of an Era: OPEC's Temporary Retreat", *in* Richard B. Finn, *US-Japan Relations: A Surprising Partnership, Centre for International Affairs*, University of Harvard, Transaction Inc., 1987;

Rachana Raizada, "De-risking Wind: Hedging Against Variability", *Renewable Energy World.com*, 2 April 2013, http://www.renewableenergyworld.com/rea/news/article/2013/04/de-risking-wind-hedging-against-variability?page=all;

Christopher A. Schindler, "Energy derivatives: the likely impact of derivatives regulation on North Dakota utilities", Presentation to the North Dakota Law Review Energy Law Symposium, 9 April 2010, *North Dakota Law Review*, Vol. 85, 2010, http://web.law.und.edu/lawreview/issues/web_assets/pdf/85/85-4/85NDLR907.pdf;

Anne Ku, "That exotic option called power", *Energy Risk,* December 2002, http://db.riskwaters.com/data/eprm/pdf/december/management.pdf;

Elias Hinkley, *Securitization: The Future of Solar* Finance, 6 November 2013, The Energy Collective, http://theenergycollective.com/eliashinckley/298666/securitization-future-solarfinance;

Economist Intelligence Unit, *Risks and Renewables: Managing the Risks in Renewable Energy*, The Economist, London, 2011, http://digitalresearch.eiu.com/risksandrenewables/report/section/part-iii-transferring-renewable-energy-risk;

Roderick Bruce, "Making Markets", *Energy Risk*, July 2009, http://db.riskwaters.com/data/energyrisk/EnergyRisk/Energyrisk_0709/markets.pdf;

David Toke, *A Proven Solution: How to Grow Renewables with a Fixed Feed-in Tariff*, Friends of the Earth, undated, http://www.foe.co.uk/sites/default/files/downloads/david_toke_fits.pdf.

(to repeat) the trade does not rely on actual ownership of the share whose future price is being traded.

The very concept of "capital" is being reworked, since both "capital" (in the form of the derivative) and its ownership are "separated from the ownership of both direct physical assets and the legal representations of those assets".[200] Moreover, by creating the possibility for one form of capital (shares for example) to be tied to another (interest rates or foreign exchange rates) through a single contract, derivatives give their owners "exposure to several underlying asset values within one, combined form of capital".[201] And, because this capital is no longer embedded in ownership of the underlying asset, it can easily and (with computers) rapidly be transformed from one form of capital into another: a treasury bond, for example, "can be converted into a credit default swap and that into a foreign exchange option at virtually no cost and virtually instantaneously".[202]

Taken as a system, argue Bryan and Rafferty, the millions of derivative contracts traded every day "involve a huge market process in which all different forms (and temporalities) of capital are priced against (commensurated with) each other".[203] As such, derivatives should be viewed as "metacapital", whose distinctive role is to establish pricing relationships that "readily convert between different forms of asset" and enable their value to be compared over space and time. In effect, derivatives are commodities whose primary function is the commensuration of other commodities, allowing rates of return to be directly compared. And it is "in computing the value of assets, and thereby determining the benchmarks of asset performance" that derivatives have achieved a utility beyond their value in commodifying uncertainty or evading regulation. They have become the mechanism through which the market (however mistakenly) "judges or perceives fundamental value", turning the very contestability of fundamental value into a tradable commodity. [204] By permitting companies and investors "to continually verify the market value of their component 'pieces' of capital", derivatives have taken "the logic of capital beyond the bottom line (annual profit rates) and into the details of each phase of production and distribution". Competition between different forms of capital is consequently intensified, as money switches between asset types in search of the highest yield, profoundly influencing all forms of profit-driven finance, from government and corporate bonds to crowd-sourced finance.

The consequences for labour are severe. Companies whose assets fail to meet profit-making benchmarks restructure by closing plants or pressing workers to produce more at lower cost. Instead of capital being embodied solely in owners (the first degree of separation) or in owners and managers (the second separation), "it is now also financial market participants such as derivative traders, corporate finance staff and financial companies (such as international banks and pension funds) that enforce the logic of capital."[205] It is "these agents of commensuration" that now decide the allocation and re-allocation of capital. Indeed, it is a measure of the central role now played by derivatives in disciplining capital accumulation that German energy conglomerate RWE now describes its derivatives trading arm, RWE Supply & Trading, as the "commercial heart" of the corporation, operating "more or less as a bank's treasury function".[206] All commodity flows go through this entity, the strategy being to generate what RWE terms "vivid interaction" between the trading arms and "sales

and origination, principal investments and asset management".[207] The business model rests on the trading arm acting both as a mediator and "a facilitator to the other business and not only a business on its own".[208]

The ways in which profit is now squeezed out of the circulation of capital has been transformed in the process, to the detriment of public welfare and the enrichment of the few, as the next "back stories" illustrate.

Back Story 2: Distancing Finance

A second back story in finance, closely related to the first, centres on efforts by capital to free itself from the constraints of geographically-specific local commons and of efforts by commoners to keep finance tethered. Capital has never been able to overcome such constraints more than partially – nor will it ever be able to. But this has not stopped it trying, with relative degrees of success and always against a varied background of resistance.

The constraints of tethering often get lost in the front story of capital's progressive evolution from dark satanic mills to clean-tech, caring, compassionate corporatism. For while the mill owners of eighteenth-century Britain were undoubtedly "rigid believers in complete mastery within their domain",[209] they were also almost all local people, not outsiders, and the finance for their mills was raised from their own savings and those of their immediate local circle of business partners and friends. In Glossop, a center of the Derbyshire cotton spinning industry, John Bennet and John Robinson were originally local clothiers; the Thornleys, local carpenters; the Shepleys, Lees, Shaws, Garlicks and Platts were sheep farmers from the neighbouring dales; the Wagstaffs and Hadfields freeholders from Whitfield; and the Sidebottoms freeholders from Hadfield.[210] They had made their way in the world and, as the brutality of the early factory system attests, were prepared to go to extreme lengths to ensure that their investments (generally earned rather than inherited) paid off. But brutality has its constraints: it can generate fierce resistance, not least by workers but also by those outside the workforce whose livelihoods are threatened.

Where capital is bound to a particular local commons and embedded in its local social networks, these limits are more pronounced than where it owes no allegiance to place. In such circumstances, "grinding despotism" is never the complete story, much as it may suit the narrative of the grand liberal progress of capitalism (and, indeed, the counter story of resistance to capital).[211] Living and working in the same communities where their mills operated, they were known to their workers and ultimately shared the same commons in the event of hardship. If there was "trouble at t' mill", it would be the mill owner's house that pitchfork-bearing workers would march on. And while mill owners could rely on the local militia to put down such opposition, they could not rely on the authorities in the event that (as often happened) their business failed. As political economist David Harvie writes, relationships between workers and capital remained face-to-face and thus quite personal: "the industrious Victorian factory-owner would probably have spent almost as long each day stalking his satanic mill as his overworked 'hands'. What's more, his livelihood was on the line, just as theirs were. If his

business failed, his creditors wouldn't spare his horse, his home or his wife's silk."[212]

While management and workers were certainly not "all in the same boat", the identity of ownership and management and the embedding of the owner-manager in the local community limited (to an extent) the profit that could be squeezed from labour. Shrewd commonsense, if nothing else, led many to recognize the need for a degree of benevolence, albeit shrouded by the self-righteousness of "bettering" their employees. Richard Arkwright, for example, ran his mills on a 24-hour production schedule, with 12-hour working shifts and massive employment of children. Conditions were appalling. Nonetheless, he also put in place practices aimed at encouraging a sense of co-operation between management and workers, including bonuses, distinctive clothing for "prize workers", and annual outings and dinners, practices that had been copied by numerous other mill owners by the end of the 18th century.[213] And just the social responsibility reports of multinational companies today act as propaganda aimed at containing opposition to the companies' practices, so the nineteenth century saw the publication of a spate of widely-read "mill fictions", novels that sought to counter criticisms of the mill system (such as Mrs Gaskell's classic "condition of England" novel *Mary Barton*) by transforming the portrayal of mill life from one of brutality into one of gritty loyalty of mill workers to their workplace and its culture. In J. Marshall Mather's *By Roaring Loom*, for example, "an old weaver who has spent her working life in the mill returns to her looms after retirement: 'hoo were as tender wi'em as if they'd been childer, nay flesh and blood were'nt i'it'."[214] It was, in part from these tales, in part from the realities of capital *having* to contain opposition through benevolence, that a further front story began to emerge, propagandized by social commentators such as Charles Babbage and Christian Socialist Arthur Helps. Industrial society was increasingly cast as "a kind of 'family' in which factory owners and managers exercised a kindly supervision and control over their children".[215]

But "benevolence" and propaganda could only take capital so far, a constraint that continues today and will continue tomorrow. So long as owner-managers were embedded in particular local social networks, accumulation would always be more vulnerable to local resistance and the constraints of local allegiances than where no such ties existed. Untethering capital from allegiances and obligations (other than those determined by capital itself) to specific local commons, or at the very least loosening those ties, was thus a challenge that faced early industrialists and continues today. The joint stock company was one effort to overcome the problem, derivatives are another, and the severing of the face-to-face ties between borrower and lender through the creation of a secondary market in loans a third (*see* Box: "Never Let a Crisis Go to Waste"). Private equity is a fourth response (the giveaway is in the name). Not only are investors able to anonymize their investment entirely through the legal structure of the fund. In addition, the investment strategy of achieving high returns by rapidly "flipping" companies (restructuring them and then selling the investment) means that private equity funds rarely become linked even at a distance with any given community for more than a few years. High-speed trading, where investments only "touch the ground" for milliseconds, is a further example of efforts to distance capital from place.

Indeed, what all such financial projects have in common is the disembedding of capital from specific local commons and its reembedding in social and political networks of power located elsewhere, where, on a personal level, capital confronts or hobnobs with capital alone – corporate boardrooms, stock exchanges, gentleman's clubs, multilateral development banks, city trading rooms, philanthropic donor functions, rock festival VIP enclosures and the like. Such distancing has not only greatly increased the ability of capital to extract profits (investors who have no fear whatsoever of those affected by their investments are more likely to treat the investment solely as a pecuniary affair). It has also augmented its bargaining power over labour. For, just as labour's power ultimately rests on workers being in a position to withdraw their labour, so companies rely on threats to move elsewhere to enforce the background conditions for their profitable operation: the fewer the social, political and economic allegiances that owners owe to particular communities, the more credible the threat and the more easily it is achieved.

Ultimately, however, capital can *never* evade entanglement with locally specific commons.[216] To extract surplus value, it has to "touch the ground" somewhere, engendering the potential for resistance. Speeding up the time spent on the ground leads to the threat of capital controls to protect against the broad economic impacts of volatile flows of capital. Hiding behind anonymous front companies leads to calls for the disclosure of ownership. Even an energy trader using a computer programmed to extract profit from arbitraging minute differences in price by the microsecond, unconnected by personal relationship to any

Never Let a Crisis Go to Waste: Finance's Response to OPEC

Innovations in the tools used by finance have rarely resulted from the mechanical implementation of some grand master plan or abstract economic theory. They are instead the outcome of "bricolage" – defined by the Centre for Research on Socio-Cultural Change (CRESC), a British research network, as the "creative and resourceful use of materials at hand".

The form that innovation takes reflects improvisations made over time by individuals who spot the profit-making opportunities presented by specific events and capitalise on them through modifying everyday practices. Such events may come out of the blue (like Hurricane Katrina, quickly exploited by weather derivative traders to launch the Chicago Mercantile Exchange's Hurricane futures index); they may emerge from regulatory efforts to constrain finance (as one financier has put it, "every regulation is an opportunity for arbitrage"); or, again, they may be self-generated by traders themselves, for example through dedicated research to identify opportunities to capitalise on tax loopholes or arbitrage other regulatory regimes.

The process is self-reinforcing. As the financial bricoleurs get to work, often using social networks of power that are outside the formal institutions of finance or the purview of regulators, their products become "the next event" from which still new structures can be fashioned.

Two uses made by finance of the "oil crises" of the 1970s and early 1980s are illustrative. One relates to the transformation of loans into an asset class; the other to the construction of futures markets in oil and gas.

From Loan to Asset Class

To spread risk and increase the size and volume of loans, bankers have long syndicated loans, with a lead lender inviting others to participate in a single loan. Loan syndication was

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widely used to finance ships for the spice trade, wars and even the speculative purchase of tulip bulbs during the Dutch tulip bubble of the 17th century. Syndication was a critical component in the financing of railroads (key to expansion of commerce and of extraction) during the 19th century, enabling bankers to accommodate large customers who they otherwise could not handle. For the most part, however, loans were treated as illiquid, bilateral facilities entered into by a single bank and a single lender, to be held for their lifetime by the lender. Indeed, for much of the 20th century, syndication remained a specialist form of finance, entered into on an "as needs" basis.

All that changed in the 1970s in the wake of the Organisation of Petroleum Exporting Countries (OPEC)'s 1973 decision to cut oil exports to the United States for providing military aid to Israel in the Yom Kippur War. The oil embargo was lifted in 1974 but was followed by a series of price rises, which led to a quadrupling of the price of oil. Unable to absorb the increased income domestically, oil-producing countries deposited a flood of "petrodollars" in western banks, much of it in dollar-denominated accounts outside of the US. Awash with funds, the banks sought to increase their loans as fast they could. Loan officers were sent roaming the world in search of projects that could be financed, many of them in the energy sector and the majority too big for one bank to take on alone. Syndicated credit, combining old-style relationship banking (where the lender's business relies on knowing the borrower) and publicly-traded debt (where the lender has no relationship with the borrower, only with other lenders) became the name of the game, increasing the complexity but also the pace at which deals could be put together. By the early 2000s, syndicated lending was supplying a third of all international loan financing: today, it is described by *Euromoney Institutional Investor* as "sitting at the heart of corporate finance".

Countries in the global South were a particular target for lending, a trend that started before the oil crisis, as banks looked to increase the yields on their loans by backing higher risk investments in developing countries. Millions of dollars of loans were extended to Southern countries, either to pay for OPEC oil imports or to finance massive infrastructure programmes, particularly large dams, oil and gas exploration, and power plants. Syndicated loans to Southern governments exploded – from $5.5 billion in 1970 to $53.5 billion in 1980, with bank lending to Latin America and the Caribbean rising from $4.0 billion in 1970 to $32.7 billion in 1980. The region's overall foreign debt shot up from $32.5 billion in 1970 to $242.8 billion in 1980. Meanwhile, in the US, the 1973 oil shock led to the government introducing new tax breaks and other incentives for oil and gas companies, nominally to encourage greater "energy independence", creating a frenzy of speculation in oil exploration and production.

Energy lending came to be seen by bankers as a ticket to prosperity, and many banks sought to capitalize by setting up oil and gas departments, using syndicated loans to get around regulations limiting the credit they could extend to any one client. Small banks, particularly in oil and gas producing states such as Oklahoma and Texas, also scrambled to get into the oil-lending game.

One bank, Penn Square Bank in Oklahoma City, was particularly innovative in its approach. By 1982, it had made over US$2 billion dollars of loans to oil and gas companies. In a shift from the "originate to hold" to an "originate to distribute" model of banking, Penn Square largely financed these loans by selling participation in them to over 53 other banks, such as Continental Illinois National Bank and Trust Company of Chicago. Although Penn Square went spectacularly bankrupt, the loan resale model stuck: by the 1990s, according to the New York Federal Reserve, lead banks were increasingly using the originate-to-distribute model in their corporate lending business, selling larger portions of their loans, not only at the time of the loan origination but (as with Penn Square) also in the years *after* origination.

A second oil price rise in 1981, coupled with the US Federal Reserve's experimentations with monetarism, caused interest rates to rise and pushed many Southern governments and private sector borrowers over the edge. Unable to service their loans, they defaulted, precipitating an international debt crisis. In response, a secondary market in distressed loans quickly flourished, greatly facilitated by the breakdown in the "originate to hold" model of banking, since banks now combined the role both of loan brokers and traders, "creating a significantly more liquid and active secondary market". Non-banking lenders and institutional investors were soon attracted into the loan market.

With these new entrants came a demand for new products that would provide liquidity, transferability and standardized documentation and procedures. It did not take long before the financial engineers hit on the idea of selling not only discounted non-performing loans, but also good loans – and of bundling them together into products that would provide investors with an income stream from the repayment on the loans without exposure to the underlying liabilities. An alphabet soup of derivative-based instruments – CDOs (collaterised

debt obligation), CLOs (collateralised loan obligations), ABSs (asset backed securities) and the like – hit the market in the 1990s and 2000s. Loans were transformed into an asset class. Although CLOs temporarily fell out of favour after being fingered for their role in the near collapse of the international banking system in 2008, they have bounced back, not least because the high rates of return they offer. For every investor who was selling a CLO in 2011, ten investors were buying one.

Undermining OPEC

A similar story of opportunism emerges from finance's involvement in efforts by Northern governments to contain the power of OPEC.

Prior to 1973, one-sided oil concession agreements ensured that a cartel of the biggest western oil companies (the so-called "seven sisters") not only set how much oil was produced but the price at which it was sold. OPEC was born out of resistance by the producer countries to this racketeering, resulting in a (temporary) shift in price-setting power away from the multinational oil companies.

In response, the oil companies together with their financial allies established an international oil market, the International Petroleum Exchange, in 1980, quickly followed by a market in oil futures. Instead of OPEC setting the price, this task would in future be left to Wall Street, whose interests are more closely aligned with those of the oil majors.

The move not only stimulated a period of financial innovation, including the emergence of new commodity funds linked to the price of oil, but, combined with the deregulation of controls on who could participate in futures markets, brought a flood of new speculative investors (from wealthy "high net worth" individuals to exchange traded funds, pension funds, sovereign wealth funds and hedge funds) into the oil and other commodity markets, binding finance still more closely to oil and gas interests. Oil companies also modified their accumulation strategies, establishing their own trading desks and deriving a significant part of their income from speculation in the oil futures markets. In 2005, for example, speculative energy trading accounted for one-fifth of oil multinational BP's declared profits.

The creation of derivative-based instruments such as swaps has also led to increased hybridisation of oil markets. Oil is no longer bought solely as a physical commodity to power airplanes, ships, trucks and automobiles transporting oil-based goods, but also as a hedge against the dollar falling or conflict breaking out in the Middle East (when oil prices would rise and those of other assets would fall). Such hybridisation has not only expanded the scope for accumulation through speculation but has also extended the scope of impacts that result from even small movements in the price of oil.

Sources:

Allison A. Taylor, *The Evolution of the Corporate Loan Asset Class*, Loan Syndications & Trading Association (LSTA), 2004, http://www.lsta.org/uploadedfiles/about_lsta/history/evolution-2004_update.pdf;

Jim Armstrong, *The Syndication Loan Market: Developments in the North American Context*, Working Paper 2003-15, Bank of Canada, 2003, http://dspace.cigilibrary.org/jspui/bitstream/123456789/1083/1/The%20Syndicated%20Loan%20Market.pdf?;

Vitaly M. Bord and João A. C. Santos, "The Rise of the Originate-to-Distribute Model and the Role of Banks in Financial Intermediation", *FRBNY Economic Policy Review*, July 2012, http://www.newyorkfed.org/research/epr/12v18n2/1207bord.pdf;

"BP Loses Trading-Floor Swagger in Energy Markets", *New York Times*, 28 June 2010, http://dealbook.nytimes.com/2010/06/28/bp-loses-trading-floor-swagger-in-energymarkets/;

Mark Campbell and Christoph Weaver, *Syndicated Lending: Practice and Documentation*, 6th Edition, Euromoney Institutional Investor, 2013;

Federal Deposit Insurance Corporation, *Managing the Crisis: The FDIC and RTC experience*, "Chapter 3: Penn Square", 1998, http://www.fdic.gov/bank/historical/managing/history2-03.pdf;

Blaise Gadanecz, "The syndicated loan market: structure, development and implications", *BIS Quarterly Review*, December 2004, http://www.bis.org/publ/qtrpdf/r_qt0412g.pdf;

Michael J. Hightower, "Penn Square: The Shopping Center Bank that Shook the World, Part 1: Boom", *Chronicles of Oklahoma*, Oklahoma Historical Society, Spring 2012, http://www.philliplzweig.com/files/ChroniclesofOKSpr12.pdf;

Ismael Hossein-Zadeh, "The Crisis of Third World Debt — Is There a Way Out?", *Proceedings of the 15th Anniversary Third World Conference Foundation*, 1991 (a modified version of this article was also published in the *Review of Radical Political Economics*, Vol. 20, Nos. 2 & 3, Summer-Fall 1988, and reprinted in Theodore Rueter, *The United States in the World Economy*, McGraw-Hill, 1994);

Suhas Ketkar and Dilip Ratha, "Overview" *in* Suhas Ketkar and Dilip Ratha (eds), *Innovative Financing for Development*, World Bank, 2009, https://openknowledge.worldbank.org/bitstream/andle/10986/6549/456450PUB0978010ONLY10Sept030102008.pdf?sequence=1;

Hugh C. Larratt-Smith, "Looking Back to Move Forward: The Syndicated Loan Market — Yesterday and Today", *abfjournal*, November/December 2012, http://www.abfjournal.com/articles/looking-back-to-move-forward-the-syndicated-loan-market-yesterday-and-today/;

Lauren Silva Laughlin, "A Boom-Time Debt Product is Back with a Vengeance", *CNNmoney*, 11 January 2013, http://finance.fortune.cnn.com/2013/01/11/collateralized-loan-obligations/;

A. Mugasha, "Loan Markets" *in* Gerard Caprio (ed), *Handbook of Key Global Financial Markets, Institutions, and Infrastructure*, Elsevier, 2013;

Phillip L. Zweig, *Belly Up: The Collapse of the Penn Square Bank*, Fawcett Columbine, New York, 1985.

specific production site, is ultimately vulnerable to how such arbitrage plays out somewhere around the globe, with the ever-present potential to provoke resistance. The blackouts in California in 2000 that were caused by energy trading company Enron's gaming of energy markets, including persuading power plants to shut down their power generation in order to push prices up, affected millions of households, causing deaths and bankrupting smaller businesses, and resulted in a state of emergency being declared. Commoners struck back, organizing to impose price caps that meant merchant generators could no longer generate profit by lowering their power output and putting power supplies at risk. Likewise, the oil and food price hikes in the late 2000s, created in part by speculators flooding into the commodity markets, provoked riots in many countries, leading to pressure by social movements on legislators to introduce rules that would limit speculative trading. The responses have not ended speculation (many of the trading practices that Enron employed still continue, and commodity markets would not function without some speculators to act as counterparties to riskier trades) and energy markets are still being constructed around the globe. But that is not the point, which is that whatever technical, legal and political arrangements are put in place to distance capital from where its impacts on the commons are experienced, it can never evade the reactions generated by such impacts, which inevitably provoke responses, including commons-oriented ones. However hard proponents of energy markets or commodity traders might try to promote a "front story" that blames the blackouts (or oil price hikes) on insufficient supplies of energy and the inefficiencies of public utilities, the violent back story of the assault on the right to energy for subsistence is a constant resource for those who would resist.

Such resistance takes many forms. One is aimed at keeping finance embedded in face-to-face networks that restrain profit-making and the extraction of wealth from local commons. The history of wind energy development in Denmark, for example, is primarily a history of struggles to circumscribe investment in community projects, rather than how to expand the pool of investors. Numerous locally-controlled, cooperative projects have now been established which are often cited as exemplars of decentralized and democratic energy solutions. However, as energy researcher and activist Kolya Abramsky records, community control of wind and other renewables has depended "on a number of political and legal instruments in order to simultaneously enable certain (desirable) outcomes, while suppressing other (undesirable) outcomes" (*see* Box: "Wind Energy in Denmark: A Dialectic Between Decentralized and Centralized Structures"). Critically, "there were very tight legal restrictions that simply banned investors who lived more than a certain distance from a wind turbine from investing in the wind turbine project". Laws were also introduced to cap what any individual investor could invest in a cooperative, and local banks were "legally obliged to provide easy and relatively simple cheap credit to individuals and small rural cooperatives who wanted to establish individual wind turbines or small wind-farms in their localities". Efforts to expand the pool of finance by easing the restrictions not only reduced the level of local investment but also led to larger investors getting a disproportionate share of the gains, to the detriment of community control. Clearly, there are strategic lessons

here for the many efforts worldwide to raise finance for community-owned and operated renewables through crowd-sourcing from any would-be investor.

The efforts of cooperatives and building societies in the 19th century to create means of financing that remained under the democratic, face-to-face control of their members are also instructive: many building societies, for example, limited their membership to named savers and were bound by their constitutions to be wound up once they had served the purpose of providing members with housing, thus obviating the need to expand their operations and financial base.[217] But (and here again there are strategic lessons to be learned) even the most carefully written constitution can be subverted. As the Rochdale Co-Operative discovered to its cost in 1859, external finance, especially from those who do not share the same political goals, can rapidly subvert or even destroy what has been built over many years of struggle. Seeking to purchase a new mill, the Cooperative sought outside investors: within three years, it had ceased to exist as a co-operative, its new investor members having outvoted its worker members and "converted the co-op to a conventional firm".[218]

Wind Energy in Denmark: A Dialectic Between Decentralized and Centralized Structures

Denmark has a strong history of developing locally-controlled, cooperative and municipal renewable energy projects, especially wind energy enterprises that are often held up as examples of democratic, decentralized energy solutions to be emulated.

To a certain extent, they are exactly this. People who live in windy areas have managed to come together in voluntary associations (or in some cases individually) to benefit directly from wind turbine development. Many energy consumers have become energy producers. Many rural inhabitants have gained not only energy for themselves but also additional monetary income and a high level of expertise.

This decentralized process has not been entirely self-standing. It has depended on several political and legal instruments to enable certain (desirable) outcomes, while at the same time suppressing other (undesirable) ones.

Three pieces of legislation related to investment have been key. Tight legal restrictions were put in place that simply banned investors who lived more than a certain distance from a wind turbine from investing in it. A legal maximum limit was put on the amount of money that any individual investor could put into a cooperative. Local banks were legally obliged to provide easy, cheap and relatively simple, credit to individuals and small rural cooperatives who wanted to establish individual wind turbines or small wind-farms in their localities. The effect of these three legal instruments combined was to provide substantial support for decentralized and democratic renewable energy use.
But in the early 1990s, a new liberal government eased or lifted some of these restrictions, particularly those stipulating that investors had to live within the vicinity of the turbine and limiting the maximum level of investment. As a result, local investment was discouraged while larger investors started getting a disproportionate share of the gains. (Some of these changes have subsequently been partially reversed, following another change of government.)

Another critical legal intervention that enabled the renewable energy sector to thrive was a ban on new-build coal-power stations.

In addition, the establishment of a national wind energy testing centre, the RISO laboratory, boosted wind energy development.

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Wind energy development in Denmark, then, was enabled by structure, policy and investment. The Danish system resulted from a complex dialectic between centralized structures designed and implemented at the national level (including legal and policy instruments aimed at enabling or suppressing certain types of investment, and setting up centralized research and testing facilities), *and* decentralized implementation of renewable energy projects. National political direction and legislative frameworks were key to the developments.

The case of Denmark shows how rapidly a cherished, decentralized model of renewable energy can be created when there is a strong political will to do so, but also how quickly it can be destroyed – or at least substantially set back – when political shifts create an obstructive political and legal environment.

Kolya Abramsky
Energy Researcher

Back Story 3: Overaccumulation, Financialization and Energy

The third back story sets energy and finance within the context of the 2008 financial crisis and the mainstream response to it. Speculative bubbles, banking crises and crashes have characterized the history of capitalism and, like the 2008 crisis, arguably have their roots in what Marx identified as the long-term tendency of the rate of profit on investment to fall as businesses seek to raise productivity by investing in machinery or by expanding the scale of production, reducing the ratio of surplus value relative to total capital and thus exerting downward pressure on the rate of profit. The result can be a crisis of overaccumulation – too much money sloshing around the system in search of profitable outlets – and a tendency to seek extra profit from speculation and the expansion of credit.

The current crisis has brought to the fore a number of trends that have been bubbling away since the 1970s.[219] Most obviously, the three decades and more since have witnessed an "unprecedented expansion of financial activities, rapid growth of financial profits, permeation of economy and society by financial relations and domination of economic policy by the concerns of the financial sector".[220] Non-financial enterprises have themselves become increasingly involved in financial processes: small energy generators, as much as large energy conglomerates, for example, are now obliged to become futures and options traders in order to hedge their price risks, while many multinational companies finance even their wage bills by issuing commercial paper in open markets.[221] With yields from conventional securities, such as stocks and shares, declining, companies are forced to keep their share prices up and boost quarterly returns in order to retain shareholders and attract new investors: workers are squeezed, factories are "offshored" to low wage countries, investment in new plant and the deployment of new technologies deferred, and research and development budgets cut. Instead, funds are diverted to boosting "shareholder value", not least by gaming the tax system and financial engineering. Here derivatives have played a major role "by saving

companies transaction costs, by giving the impression that risks are lower than in reality, by appearing to represent wealth that can be used as collateral for loans and by generating recorded profits based on speculation-driven prices".[222] Banks also shifted tack, using derivatives to shorten the period of circulation of capital (for example, by bundling up mortgages and selling them rather than waiting for them to be repaid)[223] and earning their profits principally from fees, commissions, trading the products of money and other forms of what the Centre for Research on Socio-Cultural Change has termed "organized looting".[224] The period also saw more and more aspects of everyday life being mediated through the financial system, as the state withdrew from the provision of public services such as housing, education, health and pension provision, instead turning them over to the private sector.[225]

Such "financialization" is just one possible response to crises of accumulation. Others, around which many social movements have coalesced, emphasize reducing the power of financial markets through bringing the provision of public services back into public hands (the numerous referenda initiated by citizens throughout Germany over the remunicipalization of Germany's energy sector being one example);[226] banning derivatives and reducing the need for hedging against price risk by reintroducing price controls and price support; or exploring ways of taking pension funds out of financial markets and investing them directly in rebuilding local economies, as in the case of Enfield Council in North London,[227] or, as with the National Union of Metalworkers in South Africa, in community off-grid energy (*see* Box: "Building a Socially-Owned Renewable Energy Sector"). Pushing back against such campaigns, governments are imposing a new round of neoliberal austerity measures, privatizing anything that is left to privatize, slashing welfare and criminalizing those who oppose.

Although rarely linked in discussions of the crisis, issues of energy and energy finance are part and parcel of such struggles, not least because stimulus programmes to increase investment in energy and other infrastructure form a key element, along with austerity, of capital's response to the crisis. Many on the political left have welcomed such stimulus packages as evidence of a shift towards a new Keynesianism that would use more state action to manage demand. But far from constituting a retreat from neoliberalism or a renewed state commitment to meeting "unmet development needs" (a constant refrain is the plight of the 1.3 billion people in the world who have no access to electricity), the planned infrastructure spending is better viewed as yet another attempt to satisfy the insatiable demand of investors for "yield". Central to all the stimulus programmes is a push to leverage private sector investment, on the grounds that states are not in a position, after the financial crisis, to meet the huge costs involved. As with other austerity-promoting arguments, this claim is highly contested.

Considerable untapped pools of public money exist in many countries, notably public pension funds for state employees, that could be used

for public sector investment in infrastructure.[228] Governments could also restore their depleted coffers by abandoning the low-tax regimes imposed through neoliberal structural adjustment programmes, or by clamping down on tax evasion and capital flight. But such policies would mean dismantling the political and economic alliances that underpin

Building a Socially-Owned Renewable Energy Sector

The National Union of Metalworkers of South Africa (NUMSA) organizes and represents workers in a range of industrial sectors connected to energy: the electric power sector; energy-intensive industries, such as steel, chrome and other smelters; the automobile, engineering and manufacturing sectors; and factories that manufacture and assemble renewable energy infrastructures, such as solar water heaters and small wind turbines. At its recent Special National Congress, the union decided to begin organizing workers in other sectors including mining, petrochemicals, petrol refining and certain branches of transport.

NUMSA is the largest trade union in South Africa, and is still growing. It has a strong commitment to working on climate change, and in 2012 passed two groundbreaking resolutions, one on "climate change and class struggle", the other on "building a socially-owned renewable energy sector in South Africa".

The second resolution poses the question of how to build a renewable energy sector under social-ownership. It rejects the way in which current processes are handing the expanding renewable energy sector over to private (mainly foreign) companies. It is based on an understanding that it is not enough to have the occasional socially-owned energy project: rather, the entire renewable energy sector (as well as the energy sector itself) needs to move in this direction. The resolution does stipulate, however, the need for a mix of different forms of ownership in the renewable energy sector in the very initial stages, including cooperative, community, municipal and state-ownership (via parastatal companies), and advocates cooperation and coordination among these different forms. The key premises, however, are that these different units should be controlled democratically, and that the aim of energy production should be to serve people's basic needs, not to generate profit.

NUMSA is aware that building a socially-owned renewable energy sector will require huge amounts of money. Rather than appealing to the private sector, it is discussing how workers' own money – their pension funds – can be invested. This is very important, as pension funds constitute a great source of wealth for workers. The pension fund to which most NUMSA members contribute has already made significant decisions to move into renewable energy, and discussions are underway on the importance of social-ownership.

Importantly, NUMSA's approach towards renewable energy is not divorced from wider South African struggles for control of the country's wealth, for instance, the struggle to nationalize the coal mines. NUMSA has called for part of the wealth that nationalization would bring to be channelled into funding a socially-owned renewable energy sector. This would mix central ownership in the coal sector (with participatory democratic control) with funding for a range of decentralized and centralized ownership and control structures within the renewable energy sector.

NUMSA is also linking discussions of ownership structures in the renewable energy sector to the question of ownership in energy intensive sectors (especially the smelters) with a view to nationalizing them. It also strives to make cheap, affordable electricity a basic constitutional right.

NUMSA, together with the Food and Agricultural Workers Union (FAWU), is also striving for land reform. Although motivated by other reasons, land reform is nonetheless essential if poorer rural communities are to benefit from decentralized rural renewable energy solutions. Critically, NUMSA does not favour decentralized or centralized renewable energy solutions per se, but rather advocates an integrated energy system that serves NUMSA's wider goals of political and economic transformation towards socialism.

Kolya Abramsky
Energy researcher

Source:

This box draws on experience working on energy issues with NUMSA between 2011-2013. It has been written in an individual capacity, and does not claim to represent NUMSA. For further information, *see* www.numsa.org.za.

the current relationship between the dominant elements of the state and private sectors, a relationship in which state power is brought to bear not to restrain accumulation but to enable it, be it through privatization, intervention, regulation or, indeed, deregulation.[229]

Indeed, the stimulus programmes seem primarily aimed at absorbing overaccumulations of capital, with profound implications for what gets financed, who has access to it, and who will pay the long-term price when (as is inevitable) the bubble bursts. Understanding the back story of how financialization has played out in the energy sector may therefore help activists seeking to build alliances with those campaigning on the impacts of financialized capital, not least austerity. Indeed, which side of the "coffers are bare" argument one stands on is key both to the trajectory of austerity as a response to financialization and the trajectory of energy.

Financialization has affected countries and sectors of the economy in different ways, which have themselves shifted over time.[230] But within the energy sector, some broad responses are clear. As might be expected, one has been speculation. Although many energy companies regularly claim that their derivative trades are purely for hedging purposes, research in 2012 by a team of accountants at the Kellogg School of Management and the Indian School of Business suggests otherwise.[231] The researchers examined the corporate filings of 87 oil and gas companies and found that "more than six out of every ten firms studied" use derivatives "for purposes other than managing risks", notably to boost their earnings, even at the cost of greater price volatility, "so that they can meet analysts' projections". A 2010 study of twelve of Norway's hydro utilities also reveals that their hedging strategies were a source of "substantial profit" for the companies.[232]

But focusing on speculation alone misses the broader trajectory of financialization. While speculation is used by energy companies in an attempt (often unsuccessful) to boost profits, capital has not simply abandoned production for the realm of finance.[233] Rather, the day-to-day operations of energy generation, distribution and consumption have been sliced and diced to become points at which profit can be extracted through financial engineering. Finance has, in effect, become internal to production, not separate from it. Assets – from shares to loans to power stations or oil wells – become building blocks for the construction of intricate webs of derivative transactions.

Thus a power plant ceases to be just a generator of electricity: from the moment that it is conceived as a "project" that requires finance though its construction and operation, it becomes a generator of multiple financial instruments, criss-crossing sectors and commodities, that anyone, not just the owner of the plant, can buy and sell. Raising the finance to build the plant no longer involves (as it did in the past) going to a bank (or even a group of banks) and seeking a loan, which then remains on the banks' books until it is repaid. Instead the loan is distributed via what the New York Federal Reserve has called "a daisy-chain of non-bank financial intermediaries",[234] each making use of derivative-based instruments to complete their part of the deal and taking fees at each step in the process as the loan is sliced, diced, packaged and repackaged into numerous new products,[235] each product in itself a building block for more derivative-based trades.

To obtain the loan, the power plant owner will need to satisfy the bank that the future income stream from selling the plant's electricity will

be sufficient to service the debt. It may do this through entering into a long-term power purchasing agreement with a buyer, guaranteeing the price it received for the energy it produces; in which case, a credit default swap serves to insure against the counterparty to the agreement going bankrupt. Or it may buy a derivative-based put option that gives the generator the right to sell its power output for a given price, no matter what happens to the overall market price in the future.[236] As for the loan itself, it is generally no longer held by the originating bank or syndicate of banks but securitized, again using derivative-based instruments. In the first step in the process, the loan (or the right to the repayments) is typically sold to a "warehouse" bank, which pools it with other such loans. The pooled loans are then sold to an administrator, usually a subsidiary of a large commercial or investment bank, which then creates a special purpose vehicle (SPV) to hold the loans. The SPV then issues derivative-based securities (known as Collaterized Loan Obligations (CLOs)[237] that give investors the right to the income from the loans (but not to the underlying assets) against its portfolio of loans, which are subsequently sold by an underwriter, typically an investment bank, to investors.[238] Along the way, further derivatives, in the form of credit default swaps, are often used to "enhance" the creditworthiness of the loans and thus the rating of the bundled loan portfolio.

Once built and operating, the power plant offers further opportunities for derivative dealing. Indeed, as long-term fixed-price contracts increasingly give way in many jurisdictions to market-based pricing in which prices change minute by minute and "units of virtual energy . . . fly around cyberspace from counterparty to counterparty",[239] derivatives have become part and parcel of energy generation and distribution. Futures and options are now regularly used to lock in the price that the operator receives for the electricity produced, along with other more complex cross-commodity options that hedge adverse power and fuel market movements, such as "spark spreads",[240] which give the purchaser exposure to the price difference between the price of electricity sold by generators and the price of the fuels used to generate it.[241]

In fact, viewed through the lens of derivative traders, power plants *are* a spread option and electricity *is* a "compound option", that is, an option on an option (or as one commentator puts it, "energy from a power plant is an option on the capacity [of the plant], which itself is an option on the input fuels").[242] The bill-paying public, too, become a "human revenue stream"[243] whose monthly payments can be targeted for securitization, a practice that has been used particularly where electricity utilities themselves have a poor credit rating but where their revenue streams, if packaged into a separate company, receive a higher rating, against which funds can then be leveraged. The practice was widespread in the late 1990s in the US.[244]

Alternatively, the money received from securitization can be used to pay out larger dividends to shareholders, as the UK's Thames Water did in 2007.[245] And, beyond the power plant and the utility, the energy supplied generates the possibility of still more derivative-based contracts as manufacturers produce goods and seek to hedge against their own price and currency risks. Indeed, anthropologists Edward LiPuma and Benjamin Lee calculate that a $250 million contract involving manufacturing in multiple jurisdictions and transactions in several currencies could be used to construct nearly a half a billion dollars in derivatives trading, just for the purpose of hedging risks.[246]

Beyond the use of derivatives and other forms of financial engineering to create multiple points at which profit can be extracted, governments, finance, infrastructure companies, private equity funds, sovereign wealth funds, banks, environmentalists, oil and gas companies and hedge funds are also constructing the subsidies, fiscal incentives, capital markets, regulatory regimes and other support systems necessary to transform "infrastructure" into another new asset class. This has implications for the penetration of private interests into the public realm that go far beyond past privatization programmes. To attract infrastructure investors, for example, a menu of new subsidy or corporate welfare mechanisms has been rolled out, from public-private partnerships[247] to new financial products aimed at "de-risking" private sector investment in infrastructure, including energy projects (*see* Box: "Building Markets and Subsidies"). The Indian Government has initiated an $11 billion fund to provide debt finance through tax-free infrastructure bonds[248] and a range of tax breaks.[249] Other countries are competing to put in place similar "investor-friendly" infrastructure regimes. In the Philippines, which is seeking to attract $10 billion a year from private sector infrastructure investors,[250] the government recently announced that it would guarantee *all* infrastructure przojects built on a Public-Private Partnership (PPP) basis against "regulatory risk",[251] that is, the risk that future environmental or social regulations might undermine the profitability of investments. This, of course, amounts not only to a promise to divert taxpayer money to construction companies, but also to an indirect commitment by the state to undermine the promulgation or enforcement of environmental or public-interest laws – and, ultimately, to fight citizen efforts to defend community subsistence and survival wherever they threaten corporate encroachments.

In Indonesia, similarly, the government has set up a fund to compensate investors who "lose out" from "unpredictable government policy changes".[252] Meanwhile environmentalists are teaming up with investors, financiers and multinational development banks to put in place government-backed guarantees under which the public would take the first losses on securitized renewable energy bonds, considered by investors to be high risk instruments. Far from there being no money in the public coffers, it would appear that there are considerable sums available – provided they are directed at enabling private companies profitably to enter the energy "infrastructure space".

To bring in investment, a "pensions grab" has also been unleashed. In many countries, laws preventing public pension funds from investing in riskier financial assets, such as infrastructure projects, are being overturned. South Africa and Nigeria have already rewritten their pension laws, while a number of other countries are planning to do so. Investors predict that the changes in South Africa's legislation could lead to a ten-fold surge in pension fund investments in hedge funds and private equity funds, a high proportion of which (it is hoped) will make its way to infrastructure development. China has also opened the way for insurance companies not only to invest in private equity funds, but also to raise private equity funds[253] themselves, generating what *Private Equity International* describes as "another rich vein of capital to potentially tap into on the fundraising trail".[254] In India, controls limiting investments in infrastructure by foreign pension funds have been loosened and further deregulation is expected.[255]

Building Markets and Subsidies

The push to transform infrastructure into an asset class is inseparable from a wider project, as yet far from complete, whose purpose is to enshrine markets, rather than democratically-accountable decision-making, as the means through which infrastructure is not only financed but its disposition decided.

US investment bank Goldman Sachs, one of the original architects of infrastructure funds, whose alumni now hold key positions in many of the world's most powerful policy-making institutions, is explicit about the agenda. In a paper modestly entitled *Building the World*, it identifies private-sector financing of infrastructure as both a driver of financial innovation and a builder of capital markets, stimulating the dismantling of "current onerous restrictions on investments", the growth of derivative-based products, and the opening up of developing-country economies to foreign banks.

But the core of Goldman Sachs' proposals for *Building the World*, shared by most private equity infrastructure fund investors and promoters, is the role it envisages for the state. On the one hand, it demands that "governmental interference" be kept "at a minimum", while, on the other, it envisages its entire political project being underwritten by the continuation (and extension) of a raft of state subsidies in the form of "public/private partnerships, government credit guarantees, and coinvestment by governments", not to mention the use of sovereign wealth funds, tax holidays and tax breaks for projects domiciled in tax havens.

The cost to the public of public-private partnerships (PPPs) in the UK has been huge, while the private sector has walked away with large profits. In developing countries, projects have frequently failed to deliver promised services while hiking prices for health care, transport, energy and water far beyond what poorer people can pay. Despite this, the World Bank and other multilateral development banks are pushing for a new wave of PPPs in developing countries – and many governments are obliging, with the Philippines, India, Mexico and Brazil, among others, all recently announcing new programmes.

Indeed, the deepening and extension of PPP programmes is a major reason why many investors (ever alert to public subsidies that might be captured for private profit) are investing in private equity infrastructure funds and other means of tapping the giant public ATM that PPP-backed infrastructure development has created.

And when the bills finally come in, it will be the poorest people in the world who suffer through cuts in public services to pay the hidden debt.

The implications for working people are profound. In countries where pension funds are already allowed to invest in riskier assets, workers have seen their retirement benefits slashed to make up for the massive shortfalls (over US$1 trillion in the US) incurred through fund managers having chased high-risk "alpha" returns.[256] In the US, a study by Dean Baker of the Centre for Economic and Policy Research reveals that public sector workers are some $850 billion poorer today as a result of their pensions being invested in stocks and exposed to mortgage-backed securities than they would have been if fund managers had invested in safer Treasury bonds.[257]

The fund management industry's response to pension shortfalls has not been to shift towards safer investments but to lobby (successfully in a number of states) for "reforms" that would *require* public pension funds to seek higher returns by investing in "alternative investment" vehicles such as hedge funds and private equity funds: by law, workers' money is thus to be committed to investments that place workers' future benefits at risk while ensuring a steady flow of hefty fees to already well-paid fund managers. Great news for Wall Street and the City of London: not good news for the mass of ordinary working and unemployed people.

Behind the push to transform infrastructure into an asset class is a quest for high yields. Private-sector investors, whether fund managers or companies or high net worth individuals, are not charities: they invest where they can make profits and are very clear about this. In Europe and the US, this typically means returns of 10-15 per cent on energy infrastructure projects.[258] For developing countries, the profits demanded are often twice that or more (the US-based private equity fund Emerging Capital Partners (ECP) reports returns of 300 per cent on its investment portfolio, which includes a number of energy-related investments).[259]

This has a number of consequences that puts the trajectory of private sector infrastructure development on a collision course with positive economic and social justice outcomes. One is that privately-financed and -managed infrastructure is hardwired for social and economic exclusion. Only those who can afford to pay get to enjoy its benefits: the rest, in the jargon of economists, are "rationed out of the market". As the International Energy Agency acknowledges, this makes private sector financing unsuited to electrification programmes that are aimed at reaching the poor.[260] To which one might add that it is also unsuited to the demands of a transition away from fossil fuels, for which patient, sustained, predictable and ensured streams of finance are needed, not finance that rapidly shifts from one sector to another in search of higher rates of return.

The drive for easily- and quickly-realisable profit also skews the type of energy projects that get financed. While the International Energy Agency promotes off-grid, decentralized energy systems as the most effective means of extending access to electricity, the dynamic of institutional investment is towards large, on-grid projects. In North America, for example, utility-scale projects such as wind farms and solar parks get the lion's share of finance. Among the projects financed in 2013 were the MidAmerican Renewables' 681 MW Solar Star photovoltaic project in California, at US$ 2.5 billion, and EDF's Blackspring Ridge wind farm Phase One, at 299 MW and US$ 588 million, in Alberta, Canada.[261]

Institutional investors need to invest at such a scale in order to reduce their transaction costs: as Mary Wenzel, Wells Fargo's senior vice-president and director of environmental affairs, candidly admits, "We can't do a lot of small investments."[262] Project finance deals under at least $100 million do not even get considered by the majority of institutional investors.[263]

Pension funds are averse to direct investments in renewable energy projects, both because they are relatively illiquid (that is, they are not easy to sell without incurring unacceptable losses if unexpected cash needs arise) and because they require a fine-grained knowledge of local particularities, which most investors (other than the largest funds) do not have. Energy efficiency schemes are similarly viewed as "too difficult" by many investors: they are deemed "too scattered, too small, and too technical – all for comparatively low returns"[264] – and they provide no asset that can be used as security. (Financial engineers are working on this, however: one proposal is to "transform energy efficiency into a tradable commodity by bundling [energy efficiency] projects and using them as hedging instruments against the volatility of fuel prices",[265] an approach briefly implemented by Enron in the late 1990s).

Small-scale *de*commodified energy projects, controlled *by* local people *for* local people, are thus unlikely to feature in the portfolios of the pension funds and other institutional investors. Indeed, revenues from remote microgrid projects are currently too small to attract the big investment funds (currently the revenue stream *globally* stands at just US$3 billion and, though it is expected to grow to more than $8 billion by 2020, the sums involved are small beer in comparison to global revenues from large-scale projects). Direct investments in off-grid schemes are likely to remain a niche field.

More likely, investors will plump for investing in companies that manufacture or design such off-grid schemes, hoping to benefit from *publicly*-funded contracts for off-grid village electrification, university and hospital schemes or from companies adopting off-grid technologies for commodity extraction (remote mines that need a source of power) or to lower their energy costs (while still maintaining fossil fuels as a backup). "Remote military" uses of off-grid structures are also seen a potential market.[266]

Overall, the direction of travel is profoundly undemocratic. Key decisions relating to infrastructure investment become the prerogative of small elite of private investors and companies located in a small number of countries, all of them in the North. Detailed research by the US-based Climate Policy Institute suggests that only 120-150 institutional investors are large enough to invest directly in projects. Most of the funds they handle are concentrated in just six countries, all in the North, or (in the case of insurance funds) in a small number of companies in each region.[267]

Put another way, a clique of perhaps a few thousand fund managers predominantly based in Northern financial centres will decide what projects get finance and what projects do not, and thus (if energy policy is left to the market) the direction of future energy generation and use globally. The infrastructure favoured is that which maximizes profits. If poorer people feature at all in the discussions of investors and developers, it is almost exclusively as providers of labour time (the UK's Department for International Development is explicit that a prime "benefit" of bringing electricity to poorer communities is to extend their working day)[268] or as obstacles to be removed.

Even if the interests of private-sector developers could be brought into alignment with those of the general public, however, the demands of investors for above-market profits make private equity a poor source of funding for essential infrastructure. One reason is that it is too fickle. To avert catastrophic climate change, for example, sustained, predictable and assured streams of finance are needed to fund the transition away from fossil fuels. But private equity investors remain invested only so long as their investment achieves or exceeds its benchmark growth rates. Clean Tech funds, which until recently accounted for some 10 per cent of private equity energy investment and had been enjoying a boom, began to falter in 2009, with investment in the sector declining by 30 per cent in the third quarter of 2010. Many predict that the bubble will soon burst – at which point, the financing will dry up as investors move to other, more profitable sectors.

Indeed, private equity is a prime example of what US economist James Crotty has termed "impatient finance". Private equity funds do not

just bring finance to a company; they also bring a culture and a set of financial priorities that are centred on enhancing short-term shareholder value. Even after the funds have been disinvested, this culture tends to remain, not least because attracting and retaining future investment depends on showing healthy returns to shareholders.

As infrastructure becomes more firmly entrenched as an asset class, one consequence is thus likely be a progressive financialization of companies throughout the entire supply chain – from the companies that build infrastructure to those that service them. The means through which future shareholder value will be boosted and extracted remains to be seen. But, if past history is a guide, layoffs, casualization of labour, share buybacks and the increasing use of speculative financial instruments are likely to feature prominently, along with intensified efforts to erect new derivative-based markets (for example, in carbon and ecosystem services) through which new rents can be sought from infrastructure projects. The trajectory that energy and finance takes will never be entirely settled. But it will depend on the struggles between finance-as-accumulation and finance-as-commoning. As the final section explores, the question for activists is which side they want to be on. For one thing is certain: they cannot remain neutral. Whatever position they take will affect the trajectory one way or another.

“Decentralized” Wind Energy in Mexico: Private-Sector Profits on the Back of Indigenous Communities

“Decentralized” renewable energy solutions may have regressive effects – such as dispossession of rural communities – when capital accumulation is the ultimate goal.

Furthermore, different actors have very unequal abilities to develop and make use of “decentralized” energy solutions. Wind energy in Mexico illustrates these processes.

Over the past eight years, the development of wind energy in the country, mainly in the Isthmus of Tehuantepec, Oaxaca, and to a lesser extent in Baja California, has attracted vast amounts of capital, resulting in a massive expansion of the sector. Most of the project developers are foreign multinationals; since the first pilot project in 1994, 13 large wind parks have been built. These are mainly owned by Spanish, Danish, Italian, French and other foreign companies (although one is owned by the Mexican public power company, CFE). They rely on turbines manufactured outside of the country; virtually no turbine production capacity exists within Mexico, as the country’s free trade agreements are not conducive to this.

An important, though not immediate, legacy of the 1910 Mexican Revolution was the nationalization of the country’s oil and electricity industries in the 1930s and 1960s respectively. But recent neoliberal changes, especially following Mexico’s signing of the North American Free Trade Agreement in 1994 and its various debt crises, have undermined the state’s presence in these sectors. The number of exceptions to state power generation that are now permissible has increased. This has created the conditions for shifting generating capacity from being a national or public asset to being a source of private sector accumulation. About half of Mexico’s electricity generation capacity is now in private hands.

Renewable energies, wind in particular, have proved to be the perfect vehicle for driving this back-door privatization. “Self-supply” generation has been critical. This is no longer limited to genuine self-supply, but also includes private sector producer-consumer consortia. Wind energy projects that produce electricity for the public grid are allocated via competitive bidding rounds in which preferred bidders are selected and long-term Power Purchasing Agreements (PPAs) awarded. The bidders are transnational companies, such as Iberdrola, Enel and Acciona.

The main instigators of wind projects have been private companies working with multilateral financial institutions. These assume the roles of project developers, project funders and consumers of the electricity generated. The 250 MW Eurus wind park is typical, developed by Spanish company Acciona Energy and supplying electricity to Mexican cement company Cemex. The main financial actors in the area include the World Bank Group’s International Finance Corporation (IFC); regional and national institutions such as the Clean Technology Fund managed by the Inter-American Development Bank (IADB); the Mexican Development Bank, Nacional Financiera; Germany’s private sector development finance arm DEG; France’s equivalent Proparco; the Export-Import Bank of the United States; and Spain’s Instituto de Crédito Oficial; as well as private sector commercial banks such as BBVA and Banco Espirito Santo.

The indigenous communities that own the land on which the wind projects are built are mostly critical of them. This is for many reasons:

- lack of Free, Prior and Informed Consent, which is compulsory in Mexican development projects;
- irregular, delayed and false information provided by companies and politicians;
- manipulation and coercion used to obtain extremely imbalanced land-lease contracts drafted to benefit corporations at the expense of indigenous communities;
- the overly long-term nature of the contracts, amounting to an inter-generational lock-in;
- negative social and cultural impacts caused by company operators that divide collective community structures;

- unfair economic remuneration and lack of local economic benefits from highly-profitable ventures;
- failure to honour contracts, or to honour them completely and on time;
- negative territorial and environmental impacts, resulting in negative economic impacts;
- negative impacts on subsistence crop cultivation, livestock raising and grazing, and the consequent impacts on food security;
- little or no technology transfer to the local population;
- very few permanent jobs created by the projects, most of them going anyway to people from outside the country;
- little or no benefit to the communities from the electricity generated by the wind projects, who as domestic consumers have paid a high price for their electricity for many years, and many of whom are involved in struggles against high tariffs and encounter repression as a result.

Consequently, many communities affected by wind energy projects have put up well-organized, and increasingly successful, mass-based resistance, especially indigenous organizations of fishing and peasant communities. The specific struggles vary from community to community, from wind project to wind project, as do their organizational processes.

Local and national governments, collaborating with the companies and local thugs, have come down hard on local communities. People have been beaten and targeted with tear gas. Rubber and live bullets have been fired at protesters, killing several people. Numerous leaders and other activists have been arrested or received death threats and have had to go into hiding. Resistance has blocked one major project, Marena Renewables, for the time being, although construction might start at any time.

One community, where no park has yet been built, is striving to establish its own, community-controlled wind park. However, it is facing great difficulties, and has had to resort to taking the utility company, CFE, to court for discriminating against it.

High levels of community discontent and resistance have thrown Mexico's wind energy sector into crisis. There is a growing recognition that the current policy is failing, despite the installation of more than one thousand turbines. Importantly, there is a widespread feeling that both local and national politicians are siding with multinational capital in the conflict, undermining people's confidence in existing political parties and processes. Some communities did not support any political party in the last local elections, instead defending traditional governance structures. They are facing very tough repression as a result. At the national level, a new political administration came to power in 2013 and has now embarked on an in-depth reform of the energy sector, which is likely to give even more power to multinationals.

Mexico's experience illustrates that the policy framework is key to the form that the development of wind energy takes. It can be one that supports multinational capital against communities – or one that supports communities and workers against capital; a policy framework that complies with international law – or one that violates it. A strong interventionist state politics is necessary. Failure to support communities actively can undermine people's confidence in political structures still further, leading to potential political instability, as already seems to be occurring in Mexico.

Kolya Abramsky
Energy researcher

Source:

This information is drawn from interviews with community leaders, policy makers, lawyers and those developing community-based alternatives made during two visits to Mexico. For more information, *see* http://tierrayterritorio.wordpress.com/.

Interlude: China as a New "Chimney of the World"

"The computerization and robotization of factories and offices in Western Europe, North America and Japan has been accompanied by a process of 'globalization' and 'new enclosures' . . . Instead of a decline, there has been a great expansion of factory production throughout many regions of the planet."

George Caffentzis[269]

Much of the 2000-2008 surge in the rate of emissions increase – from around one per cent to over three per cent – was due to global investors moving in a big way into dirty, coal-fired production in coastal China, as part of a sweeping globalization of production that saw foreign direct investment (FDI) quintuple worldwide between 1990 and 2009.[270] Between 2000 and 2006, 55 per cent of total global growth of carbon dioxide emissions occurred in China; by 2007, five years after China had overtaken the US as the world's leading destination of FDI and six years after its admission into the WTO and the full liberalization of investment rules, the share had risen to two thirds.[271]

By the 2000s, more than half of the goods exported from China were produced by joint ventures or – increasingly – wholly foreign-owned companies (up from a figure of 0.1 per cent during the 1980s). The more high-tech the products became, moreover, the more foreign capital dominated, with 99.4 per cent of computer exports produced by partly or wholly foreign-owned firms by 2002. Between 2002 and 2005, the share of emissions growth in China directly attributable to the presence of foreign investment rose from one-third to one-half.[272] According to one estimate, some 48 per cent of total Chinese emissions between 2002 and 2008 were caused directly by the production of commodities shipped overseas[273] – and this does not count emissions caused by the construction of factories producing export goods, highways built to connect industrial zones, apartment buildings accommodating workers, or any other infrastructural project geared to the expansion of the export sector, nor emissions from economic activities indirectly stimulated by the export boom.

The emissions surge cannot be explained, in other words, by a boom in household consumption, "changing lifestyles", a "growing population" or any official attempt to expand energy infrastructure and other services to the poorest.[274] On the contrary: the FDI-fuelled growth of coastal industry has been associated with an explosion of protest among the poor both in the cities and the countryside, as pollution spreads, land is seized and subsistence undermined.[275]

Why has moving to fossil-intensive production in China been such an advantage for so many investors? It is not that corporate investment is fleeing jurisdictions with costly carbon regulation so that the industries it supports can burn fossil fuels with impunity.[276] Historically, the

costs of complying with environmental regulation have seldom been a significant factor in investment decisions,[277] and there is little reason to believe that carbon regulation is any different. In fact, existing carbon regulation – primarily in the shape of carbon trading schemes such as the EU Emissions Trading Scheme – exerts even less of this kind of influence. Not only does it fail to penalize large corporate emitters and traders in globalized commodities; it disproportionately rewards them while undermining innovation in competing forms of energy.

Nor was the surge of investment in fossil-heavy industry in coastal China simply a response to the demands of "Western consumers". True, it is primarily Western workers who consume most of the cheap goods exported from China.[278] Yet it is ludicrous to suggest that emissions are being caused to zoom across oceans by workers "standing in front of shelves and picking cheap Chinese commodities rather than expensive domestic ones".[279] If Wal-Mart[280] and other outlets for cheap Chinese wage goods have helped allow business to get away with cutting workers' wages in industrialized countries and increasing the interest on the credit pushed on them, that was hardly labour's idea. Indeed, labour movements have tended to resist the export of manufacturing jobs. Many environmental activists' simplistic assumption that the "root cause" of climate-damaging activities is "Western overconsumption" or "consumerism" is unhelpful insofar as it renders invisible actors whose decisions matter more: corporate owners, managers and investors.[281]

The Fossil Capital Hypothesis

Rather than being due to "consumerism" or a flight from regulation, the recent flow of investment to fossil-intensive plant in coastal China is more plausibly explained by what Swedish sociologist Andreas Malm, in a pathbreaking article on which this section is based, calls the "fossil capital hypothesis". According to this hypothesis, capital that is free to invest across national borders, and capable of carrying productivity-preserving technology and management and technical expertise to new locations, "will relocate factories to situations where labor power is cheap and disciplined – where the rate of surplus-value promises to be largest – by means of new rounds of massive consumption of fossil energy."[282]

Globally-mobile industrial capital – provided that cheap, oil-fired worldwide container-shipping is available to convey goods to worldwide export markets – will choose sites above all according to whether they can provide an inexpensive, disciplined labour supply accustomed to long hours and intense work. This is precisely the sort of work portrayed by photographer Edward Burtynsky and cinematographer Peter Mettler in many of the Chinese scenes of Jennifer Baichwal's memorable film "Manufactured Landscapes". Such a country will remain a favoured destination for investment as long as it can offer a replenishable army of able workers whose wages are low (in 2002 manufacturing wages in China were around 3 per cent those of the US, 16 per cent those of Mexico, and 32 per cent those of Brazil; in 2008 they were still barely 3 per cent of those in the Eurozone)[283] and who do not show too many signs of rebellion or defiance. Almost by definition, it will be a low-income country. Probably it will also be one in which – as in Britain in the 19th century – rural dwellers are leaving the land *en masse* – in the

Chinese case, an exodus encouraged by post-Maoist industrial policy. If the army of such workers retain some (preferably somewhat loose) links with their rural homes, which can continue to pick up some of the costs of their maintenance, keeping their cost down, or on which they can fall back in times of crisis, then so much the better; in this sense a "fossil economy" that relies on coal, oil or gas for the extraction of value from masses of labour will also need to continue to be a wood or biomass economy. (In the late 1970s, 90 per cent of energy consumption in the Chinese countryside was biomass, much from agricultural waste.)

The ideal host country will also have taxpayer-supported infrastructure in place. The reliable electric power required for putting vast stores of cheap labour to flexible use in making goods for rapidly-evolving, just-in-time export markets is especially important. By 2002, Chinese industry was absorbing more than 90 per cent of the energy the country derived from coal, three-quarters of which was burned in the generation of power and heat.[284] In 2009, over 66 per cent of China's electricity consumption went to industry, as compared with only 22 per cent in the US, 46 per cent in India and Brazil, 54 per cent in Mexico, 59 per cent in South Africa, 41 per cent in Germany, 42 per cent in Italy and Sweden, 47 per cent in Finland, 27 per cent in France and 42 per cent in Thailand.[285] The host country's state must also be willing to expand infrastructure continually to meet the needs of existing foreign investors and attract still more. Thus after 2002 China's government built huge transmission lines to convey electricity from inland power plants to the industrial coast, simultaneously deregulating the coal market to encourage new coal mines of all types.[286] China also fulfilled another key investor need by undertaking huge developments in fossil-based transport infrastructure to serve both domestic manufacturing and international trade.[287] From the point of view of foreign-owned industry, China's infrastructure remains greatly superior to that of many rival cheap-labour destinations for foreign investment, including Viet Nam, India, Bangladesh, Indonesia, the Philippines, Cambodia, Burma and even Mexico.

The Case of Apple

The profit strategy employed by Apple – which, in 2011, gleaned over US$400,000 in profit per employee, more than Goldman Sachs, Exxon Mobil or Google – helps illustrate further advantages of investing in manufacturing in China.

Apple uses Chinese labour mainly through contractors. While the firm directly employs 43,000 people in the US and 20,000 abroad, an additional 700,000 engineer, build and assemble its iPads, iPhones and other devices abroad, as employees of Apple contractors. Many of these workers are located in China, not only because workers are cheap there, but also because they can be assembled in huge factories and housed close to the site. One installation belonging to Foxconn, one of Apple's suppliers, boasts 230,000 employees, many working six days a week, up to 12 hours a day. Over a quarter of Foxconn's work force lives in company barracks and many workers earn less than US$17 a day. The firm employs nearly 300 guards to direct foot traffic so workers are not crushed in doorway bottlenecks. According to Jennifer Rigoni, a former Apple worldwide supply demand manager, Foxconn can "hire 3,000 people overnight" and put them in company dormitories.[288]

The flexibility, diligence, skill and 24-hour availability of Chinese workers are also hard to match. It was a Chinese factory, for example, that Apple relied upon when it decided at the last minute to redesign the screen of its iPhone only weeks before the device was scheduled to be shipped to retailers. The replacement screens began arriving at the plant near midnight. Some 8,000 workers were immediately woken up and put to work on a 12-hour shift installing the screens. Within four days, the factory was making more than 10,000 iPhones daily. "There's no American plant that can match that," said one Apple executive.

When Apple had needed a factory to cut panes of hardened glass manufactured in New York state into millions of tiny screens for the iPad, in addition, a Chinese bidder, with subsidies from Chinese taxpayers, began constructing a new wing for the purpose and assembled a warehouse of glass samples. The bidder also made engineers available at almost no cost, and made sure employees were available at on-site dormitories 24 hours a day.

Additional advantages of Asian production, according to another Apple executive, include the fact that factories "can scale up and down faster" and that Asian supply chains for everything from rubber gaskets to custom-made screws "have surpassed what's in the US".

The Multiple Connections with Emissions Increases

Offshored production will tend to involve an increase in overall greenhouse gas emissions for many reasons. First, the cheap infrastructure laid on for foreign investors is likely to involve relatively dirty fuels and relatively inefficient production processes. In China, coal cost six times less than cleaner-burning oil in 2008 per unit of energy produced – and of course still less than solar energy – while its energy production was unmatched in inefficiency outside of India. Even in 2012, China's carbon intensity per unit of GDP from fossil fuel use and cement production was more than double that of the US, Mexico or Japan and more than four times that of France.[289]

Second, offshored production will increase each commodity's transport requirements. As the WTO adopted the slogan "made in the world"[290] as justification for longer and longer supply chains, lengthy infrastructure corridors and container-shipping, and foreign investors expanded "dirty production" not only in China but also in other countries such as Mexico, South Africa, Indonesia and Viet Nam, more and more fossil energy has been expended in getting goods from one place to another. Whereas in 1990, an estimated 20 per cent of all carbon dioxide emissions originated in the production of commodities consumed in a different country, by 2008, the share had grown to 26 per cent.[291]

Third, even if energy production in cheap-labour countries such as China does not start out more fossil-intensive than its counterpart in the industrialized North, it may well become more so as the state scrambles to mobilize more and more cheap industrial energy to attract and keep foreign investment. According to the International Energy Agency (IEA), China's energy sector carbon intensity increased from a figure

comparable to that of most of the industrialized world in 1990 – 2.57 tonnes of CO_2 emitted per tonne of oil equivalent – to a peak of 3.07 tonnes in 2008, at the same time that overall energy supply went up more than 2.4 times. The energy sector of India (according to UNCTAD the second most important destination for foreign direct investment during 2010–2012) has also become dirtier per unit of energy produced as it has expanded in absolute terms. Starting from a lower starting figure of 1.83, its carbon intensity, by 2010,[292] was 2.34, at the same time that overall quantities of energy supplied went up by a factor of more than two and a quarter. Mexico has also shown an increase in intensity, from 2.17 in 1990 to 2.34 in 2010. By comparison, OECD energy sector carbon intensity has declined slightly, from 2.48 to 2.32, as its energy production increased by 19 per cent. Overall world intensity figures have been more or less level through the period – although for the key period 2000-2006, approximately 18 per cent of the growth in atmospheric CO_2 concentrations stemmed from the "increasing carbon intensity of the global economy".[293] Considered from the perspective of the world economy as a whole, then, pockets of increased efficiency and "decarbonization" are failing to compensate in the slightest for the overall, globalization-influenced expansion of the fossil-dominated global energy sector. In October 2012, the IEA noted that coal use accounted for half the increased energy use of the prior decade, growing faster than all renewable energy sources put together.[294]

Nor does the global move toward computers and information technology necessarily herald a less fossil-dependent manufacturing regime. A laptop assembled in China requires 26.5 kilos of oil for every kilogramme of computer, and it is estimated that it takes 800 kilogrammes of fossil fuels to make one kilogramme of microchips. (By comparison, one kilogramme of automobile requires around one kilogramme of fossil fuels – although the lifetime emissions associated with cars are of course be much higher.)[295]

Fourth, as Andreas Malm suggests, other things being equal, investment will have incentives to continue moving away from locations where efficiency and decarbonization are on the rise to countries near the (shifting) current peak of carbon intensity in manufacturing: not to the poorest countries, where the infrastructure will be inadequate, nor to the richest, where rates of surplus extraction will be low, but to countries that are, for the time being, playing the role China has played in the last two decades. Of course, other things are usually *not* equal. The time it takes to transport goods from distant manufacturing sites to global markets may become a crippling disadvantage. The ability to innovate and customize products for particular markets may not turn out to be as "portable" as productivity is. Most important, labour can quickly become more expensive in sites such as China as strikes and other forms of resistance spread, at the same time that wages fall in the original country of investment. Pay and benefits for the average Chinese factory worker rose by 10 per cent a year between 2000 and 2005 and 19 per cent annually between 2005 and 2010, according to the Boston Consulting Group.[296] Strikes at Honda plants got Chinese workers a 47 per cent pay rise in 2010, while the Apple-affiliated firm Foxconn had to double the wages it pays at Shenzen following a series of suicides. In Shenzen, Fushan and Dongguan, the monthly minimum wage for all industries tripled in the decade to 2013. In February 2014, Shenzen authorities were planning to raise it a further 13 per cent.[297] At the same

time, the 2007-08 financial crisis and other factors such as the threat of new forms of mechanization such as robotics and 3-D printing have damaged the bargaining power of US labour relative to the financial and manufacturing sectors. Thus some investment is now moving back from China to the US. According to *The Economist*, by 2015, the savings that US manufacturers can make by moving to China may almost disappear. Yet locations such as Mexico and India will continue to offer great advantages, and overall incentives remain strong for industry to expand into regions where their carbon emissions will be high.

Fifth, growth in emissions attributable to globalization is not only unlikely to be compensated for by efficiency improvements in long-industrialized countries, but actually to be funded partly by them. As The Corner House's previous report *Energy Alternatives: Surveying the Territory* documented, under the dominant economic system, efficiency increases in one place or sector tend to feed into a logic of overall global economic expansion that can only make climate change worse.[298] The vaunted "energy savings" being implemented around the world are part and parcel of a pathway of continuing overall growth of manufacturing emissions, including, often, increases in carbon intensity elsewhere.[299]

Conclusion: Whose Side Are You On?

"To reorient the world energy system involves reversing the extremely powerful dynamic which has emerged ever since the beginning of the industrial revolution. This challenge must be met in all its economic, ecological, technical, political, cultural and social dimensions. [Change] will not happen unless there is a profound reform of the way wealth is produced and shared out on our planet."[300]

Jean-Claude Debeir, Jean-Paul Deleage and Daniel Hemery

"[A]ny meaningful action on climate change would at some point have to challenge the dynamics of fossil capital as a global phenomenon. That would require, first of all, a sober acknowledgment of the power relations permeating the continuous growth of CO_2 emissions."[301]

Andreas Malm

This report has argued that energy and finance are not things but political processes, trajectories, aspects of social struggles constantly raging around the world, mobile constellations of shifting forces and vectors. What are the implications for action for those committed to democracy and a livable future?

The Ambiguities of Energy Finance

The question of energy finance is radically ambiguous. When campaigners talk about financing an energy transition, which energy are they talking about? The finance of Big-E Energy or the finance of little-e "energies"? And over what time period?

It makes a difference. While Big-E Energy and little-e "energies" have formed an interacting whole since the 19th century, they have contrasting characteristics that mean they are constantly at odds with each other (*see* Table 1 below and "Modern Conflicts over Work and Energy" above). A democratic, green, global Big-E Energy regime is more or less a contradiction in terms, whereas democratic, green little-e energy regimes are perfectly possible. Activists advocating finance for a Big-E "Energy alternative" will, sooner or later, find themselves in conflict with activists advocating finance for "alternatives" that give pride of place to little-e "energies". Activists backing an "energy transition" that attempts merely to replace a few machines or fuels while extending a Big-E Energy regime will, sooner or later, find themselves at odds with activists who view the "energy transition" as a long-term transition away *from* the dominance of Big-E Energy.

It will be a critical part of activist political strategy in coming years, in other words, not to treat "energy" as a neutral thing that has always been there and that human beings have always craved more and more

of. Energy is a particular historical phenomenon inextricably tied up with unequal exchange. It has important inbuilt political biases. If what sociologist 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 alternative pathways, and cover up some of the most important issues that need to be discussed.

Nineteenth-century thermodynamics helped open up the possibility of imagining that fossil fuels were simply "one form of energy", and therefore that they could be "replaced" by another form. The temptation remains strong today to think that maybe society can get the Big-E Energy it "needs" without coal, oil and gas – or something like them. What the history of Big-E Energy reveals, however, 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 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 a world that is so strongly defined (in part) by the modern concept of Big-E Energy a world that is desirable or will continue to be possible?"

Similarly, many activists have 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 demonstrates that it 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 – in other words, to choose the wrong side in a cluster of increasingly bitter struggles.

Accordingly 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. Nor will they be formed by activists appending themselves to institutions that they may not fully understand, including international financial institutions, hedge funds, private equity firms, sovereign wealth funds and UN agencies, in the ungrounded hope that they may "control the damage" such institutions do.

They are more likely to arise among those who are united in a refusal of, or resistance to, what energy theorist 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 from each other. 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. Still others will be working ostensibly to make Big-E Energy itself fairer or more sustainable, while simultaneously undermining its dominance. Underneath, however, are commonalities that will likely emerge as more attention is paid to conflicts surrounding the development of the modern concepts of energy,

work and rural-urban relations over the past two centuries; the current terrain of enclosure, economic and financial crisis; and movements to elaborate and rebuild existing commons as well to create new ones on top of the structures associated with fossil energy practices. The result can be a more hard-headed, respectful understanding of how contemporary finance is related to energy and work that enables social movements to get tough in a less co-optable way with the interests that determine energy's structure and logic.

Common cause will need to be made with, and among, for example, anti-privatization movements, indigenous anti-extraction movements in the Andean region, movements demanding reparations for historical ecological damage, anti-austerity movements, land rights movements, Occupy, La Via Campesina, forward-looking trade unions, movements defending forest and water commons in South and Southeast Asia, movements creating new electricity commons in South Africa, Transition Towns in Europe, environmental justice communities in Southern California, and so forth.

TABLE 1.
Big-E Energy and little-e "energies: some persistent conflicts

Big-E Energy under growth regime	Little-e "energies"
Permanently scarce	Self-limiting
Cannot be equitably distributed	Rough equality possible
Favours minority at expense of majority survival	Safety net for majority
Closes out space for autonomy among both users and nonusers	Maintain spaces for autonomy
Large surpluses possible	Large surpluses impossible
Ecological protection requires professional management of "limits", with limited and temporary chances of success	Ecological protection not separated from or in necessary conflict with subsistence dynamic
Crises conceptualizable as deficiencies in technical management of quantified flows	Crises conceptualizable as the presence of or need for such management
Machines, commodified labour and capital as source of fertility (fertility as profit)	Earth as source of fertility or strength; industrial "productivity" as process of sterilization or destruction
Abstract, quantifiable, mobile, singular	Concrete, qualitative, entangled, multiple
Nature as separate and as raw material; energy and life as (capitalist) 'labour'	Nature as interlocutor, broader understanding of 'work'

Building on What Exists

> **"A person who thinks it possible to draw a blueprint for the ecological salvation of the human species does not understand the nature of evolution or even of history – which is that of permanent struggle in continuously novel forms."[302]**
>
> **Nicholas Georgescu-Roegan**

One conclusion that may be drawn from the arrow pictured on page 7 of this report's introduction – and from what has followed – is that different energy (and financial) regimes are not the result of anyone's adoption of an intellectual "model", "system" or "alternative". Rather, they are provisional, partial and internally-conflicted outcomes of continuing processes of struggle and violence. The way to contend with their destructive trajectories is not to rush to try to implement a comprehensive, preconceived alternative "model" or "system" – a strategy that would have negligible, unpredictable or counterproductive effects – but rather, through a careful examination of their dynamics, to find ways of intervening constructively and collectively in the continuing conflicts that define them. This is likely to be a more effective way of helping to shift the overall trajectory produced by the continuing encounters between fossil-powered business and the subsistence and survival-oriented practices of the commons.

Neither Big-E Energy nor little-e energies amounts to a "model" or a "system". Nor is one an "alternative" to the other – as if the boxes in Table 1 were items on a menu for God to choose among, depending on which tastes better (*see* Box: "Deconstructing 'Alternatives'"). Accordingly, it would be worse than pointless to assume – as some have done – that the upshot of the distinction between Big- and little-e energies is that *"little-e energies good, Big-E energy bad"* (or vice versa).

Even more demented would be to assume that the distinction between the two entailed a strategy of immediately shunning any manifestation of Big-E Energy and rallying behind any appearance of little-e energies. To say that the distinction between the two presupposes some sort of impossible "rejection" of the idea of Big-E Energy would be like saying that labour unions have no right to struggle unless they ignore history, abandon the idea of negotiating over wages and hours, and instead reject capitalist work forthwith, turning their backs on jobs and becoming self-provisioning organic farmers or hobos. It would be like saying that 18th-century labourers drinking sweetened tea to keep awake had no right to challenge the slavery that produced the sugar on their tables, nor reluctant 21st-century airplane passengers the right to question the Keystone XL oil pipeline.

The point of the distinction is, rather, precisely to take a longer, strategic view of how political power might be mobilized in coming energy struggles. It is to seek opportunities to begin to build more trust and mutual learning among all those who challenge, even in seemingly modest ways, the structures of wage labour and unequal exchange around which Big-E Energy was built, whether Colombian coal miners, Chinese software developers or Brazilian fishing communities. It is to search out roles for wind or solar power innovators that could, in the

long term, feed into, rather than thwart, movements for subsistence and autonomy. It is to envisage trajectories of liberation that help explode from within the processes that gave rise to Big-E, fossil Energy itself, as well as a financial system whose predations have achieved unprecedented levels.

One of the biggest steps toward the necessary alliance- and theory-building is simply to recognize and listen to the wide base of movements already working effectively toward social and political transformation. To do so is already to abandon fantasies of revolutionizing energy, work and finance through technical plans executed by expert elites through a militarized political infrastructure, or finding a "secret lever" for radical change in prices, science, ethics or new machines. For such movements invariably start from respect for where people (and things) are, not from a belief that they can be instantly transformed into what one or another intellectual grouping might want them to be, based on its necessarily tiny body of experience.

Deconstructing "Alternatives"

For elites, talk of "energy alternatives" or "finance alternatives" can sometimes open up the imagination. But such talk usually also partakes of the fantasy that action is the (successful or failed) implementation of elite plans.

The question "What's your alternative?", put to critics of the *status quo*, tends to come from people who have the luxury of regarding the *status quo* as a workable option. The global majority does not necessarily always have that luxury. By and large, activists from the global South are far less likely to ask this particular question of anybody than their counterparts from the North, because they do not need to, and because they feel that to do so would be antisocial. They know that multiple answers to such questions are already incessantly being thrown up as sparks from the struggles in which they are engaged. They are not looking for the blueprint sought by many technocratic elites. It would be costly indeed for them to regard action as the fulfillment of the ideas of planners. Alliances come first; they have to.

Avoiding the question "What's your alternative?", with its elitist and Cartesian presumptions, might be good discipline for activists seeking new ways of working together. One provisional replacement might be: "Whose side are you on?"

Such a strategy sees the deepest and most far-reaching transformations rooted in materials present everywhere, not in the constructions of one or another intellectual class. These materials include, of course, the machines of the industrial revolution, which Karl Marx predicted would someday prove to be capital's undoing, and which philosopher of labour Amy Wendling sees as "metaphors for and embodiments of the accumulated historical and scientific knowledge of the human species"[303] and as things with which new, happier entanglements may someday be worked out. More broadly, they include the materials of everyday commons practices of both North and South: networks of self-provisioning, mutual help and respect, vast collections of knowhow regarding interaction with the non-human world, practices of innovation involving the most unexpected connections, all sorts of bodies of resistance to the accumulation imperative.

Such a strategy also enlists the most diverse groups, taking advantage of their different insights about the long-term trajectory of any collection

of actions that are taken, which may or may not go under the name of "reforms", and may or may not involve decommodification. Political scientist Robert Albritton gives a flavour of the kind of thinking involved when he writes that activism in the area of contemporary finance should not be aimed merely at rescuing business and banks by "bursting specific bubbles", but at better meeting "human needs through democratic controls":

> "Insofar as reforms are effective they will not be reforms that aim to 'recommodify money' by freeing up money and financial markets; rather, they will be reforms that further decommodify money by increasing democratic control over it."[304]

Not Trying to Build on What does not Exist

Building on what exists also involves being careful not to try to build on what does not exist. Another way of viewing the upshot of the arrow of page 7 is to survey critically various strategies followed by activists seeking finance for an energy transition that do *not* engage fully with its complex political realities, and are thus likely to be ineffective. It may be worthwhile to recapitulate a half dozen of these strategies and their shortcomings:

(1) Appealing to "economic rationality" as automatically adjusting itself to public opinion in a way that forces transformation in investment. Far from going green, global investors have, generally speaking, become "browner" in the years since global warming and energy injustice became the subject of so many noisy public debates and activist campaigns, and have merely stepped up their already profound commitment to practices associated with runaway climate change. It was, for example, *after* the Kyoto Protocol was signed, *after* financial institutions and countries such as Germany began to ramp up renewable energy investment and roll out plans for greening their economies, and *after* worries that oil production was entering a phase of decline became widespread that the rate of growth of global carbon dioxide emissions tripled.[305] This spike could not have occurred without an overall acceleration in investment in dirty energy. Nor are there any signs that initiatives proposed to make finance more egalitarian, such as microfinance or post-2008 regulatory reforms, have in the end affected the widening gap between rich and poor.

(2) Appealing to "regulation" as a cure for all ills relating to energy finance. Regulation, as Italian political scientist Giondomenico Majone observes, has always been counterposed to public ownership.[306] In the 20th and 21st centuries, its role has been to help perpetuate a global system of extraction, industrial production, ever-accelerating transport, mass consumption and private profit. While regulation has occasionally helped to re-price renewable energy sources and defend local subsistence-oriented energy enclaves, there is no evidence to suggest that it is capable of restructuring the overall fossil-based patterns of accumulation that it has evolved to support. Nor is there any basis for suggesting that regulation could force the financial sector to prepare for a future without the profits

made possible by fossil-based manufacturing and transport or to relinquish its dependence on super-charged returns from advanced financial products, and instead to concentrate merely on modest, archaic forms of mediation and speculation, land investment, insurance or swindling. As political theorists Peter Bell and Thomas Sekine observe:

> "It does not seem to us that today's trade in derivatives is an anomaly that can be easily controlled by regulatory measures. For it reflects, in our view, the systemic malaise . . . of the post-Fordist economy in which idle funds routinely failed to be converted into real capital."[307]

Philosopher Paul Mattick Jr. adds pithily that since deregulation was not the cause of the recent financial crisis, but rather a "response to the pressure to speculate" deriving from falls in profits propelled by dynamics of mechanization, it is unreasonable to expect regulation to be the solution.

Both before and after the 2008 financial crisis, the banking and shadow banking sectors have repeatedly converted attempts at financial regulation, including elements of the Basel III Accord, into fresh opportunities for innovation and profiteering.

(3) Appealing to "safeguards" and "standards" as a cure for ills relating to energy finance. Like regulation, safeguards and standards derive from a dynamic that nurtures both structural inequality and continued use of fossil fuels, but are even less capable of controlling systematic and accumulating damage to both human and non-human worlds. Originating in corporate initiatives belatedly and rather servilely reinforced by NGOs, they were never conceived as means of achieving the impossibilities of "green" or "democratic" Big-E Energy.

(4) Pushing the United Nations into addressing climate change and historical international economic inequalities by channeling funds to the global South for renewable energy developments to enable accelerated accumulation there. Assuming, incorrectly, that a democratic Big-E Energy is possible, this initiative has the effect of reinforcing and supplementing, rather than replacing, fossil-based patterns of energy use.[309] Whether or not they were accompanied by continued use of coal, oil and gas, however, the new renewable energy sources would be of a magnitude and type to cause comparable damage. Like most mechanisms of "foreign aid", in addition, the proposed financial flows would likely result ultimately in the transfer of wealth from poor to rich both nationally and internationally. But the issue is likely moot, since there is little sign that the political power exists to force institutions such as the new Green Climate Fund to set aside normal business considerations that put fossil fuels first. NGO efforts to get civil society representatives or observers nominated to, say, the Private Sector Advisory Group of the Green Climate Fund will, meanwhile, merely reinforce the credit of the mainstream pushing for the extension of Big-E Energy.

(5) Looking for single catalysts, such as oil companies, multilateral development banks, specialist funds or new machines as the key to energy transformations. As this report has argued, fossil fuel use is so important to so many aspects of a modern accumulation pattern based

on extracting the most out of labour that it is unreasonable to expect such miracles. Profits and rents throughout current global systems of extraction, production, consumption and turnover are so dependent on fossil fuels that attempting to single out energy companies alone for fundamental change would be futile. Belated 2013 decisions by the European Bank for Reconstruction and Development, the World Bank, and the US Treasury Department to cut back on some funding for coal-fired power stations,[310] constitute progress, yet the fact that the change came so slowly despite, in the World Bank's case, a multi-decade campaign, is more a victory for fossil-based production than otherwise. The World Bank has since continued to roll out destructive energy funding of other kinds. The appearance of private equity funds specializing in renewable energy – such as Hudson Clean Energy Partners and Bamboo Finance – does not by itself incentivize any change in production, consumption and circulation patterns modeled on the high inputs of Big-E Energy entrenched during the fossil fuel era. Nor is energy use associated with overall cycles of accumulation going to be affected much by machine-switching alone. As Harvard University economist Stephen A. Marglin observed many years ago, "the primary determinant of basic choices with respect to the organization of production has not been technology – exogenous and inexorable – but the exercise of power – endogenous and resistible."[311]

(6) Introducing the "right to energy" as a centrepiece of energy policy. In addition to being vulnerable to being transformed into a "Trojan Horse" for the introduction of the relations of exploitation involved in Big-E Energy, this strategy conceals the need to take sides regarding that exploitation. Inviting the view that energy is a "thing" concerning which justice demands only that it be handed out fairly, it hides the relations among humans and non-humans that are implicated in all its forms.[312]

Notes and References

1. The pedestrian was anthropologist Stephanie Rupp. *See* S. Rupp, "Considering Energy: E = mc2 = (magic·culture)2", *in* S. Strauss, S. Rupp, and T. Love (eds.), *Cultures of Energy: Power, Practices, Technologies*, Left Coast Press, Walnut Creek, 2012, p.80.

2. The Nobel physicist Richard Feynman once said that "we have no knowledge of what energy is". Fellow physicist R. Bruce Lindsay, similarly, while noting no other concept "has so unified our understanding of experience", was unable to define energy except circularly as "constancy in the midst of change". Both scientists are quoted in Karin Zimmermann, "Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures" *in* Nina Mollers, Karin Zachmann (eds.), *Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures*, Transcript Verlag Bielefeld, 2012.

3. *See* The Corner House, *Energy Security: For What? For Whom?*, Sturminster Newton, Dorset, 2012 and The Corner House, *Energy Alternatives: Surveying the Territory*, Sturminster Newton, Dorset, 2013, http://www.thecornerhouse.org.uk.

4. The phrase "back story", as used in such contexts, is due to Nancy Fraser.

5. Climatologists Kevin Anderson and Alice Bows of the UK's Tyndall Centre correctly challenge the tenability of economic growth in a greenhouse world. *See* K. Anderson and A. Bows, "Beyond 'Dangerous' Climate Change: Emission Secnarios for a New World", *Philosophical Transactions of the Royal Society* A 369, 2011 and "A New Paradigm for Climate Change", *Nature Climate Change* 2, 2012. pp.639-40. *See also* http://www.slideshare.net/DFID/professor-kevin-anderson-climate-change-going-beyond-dangerous.

6. Steve Hargreaves, "A $2 Trillion Bet on Powering America", CNNMoney.com, 8 January 2009, http://money.cnn.com/2009/01/06/news/economy/smart_grid. *See also* Peter S. Fox-Penner, Marc W. Chupka and Robert L. Earle, "Transforming America's Power Industry: The Investment Challenge — Preliminary Findings", The Brattle Group, Paper presented to Edison Foundation Conference, "Keeping the Lights On: Our National Challenge", 21 April 2008, http://www.brattle.com/system/publications/pdfs/000/004/863/original/Transforming_America%27s_Power_Industry_Fox-Penner_et_al_Apr_21_2008.pdf?1378772135; Dick Flanagan, "Our national challenge", World Generation, http://www.world-gen.com/features/challenge.html.

   The Brattle Group estimates that "even with substantial energy efficiency measures", at least 150,000 MW of new and replacement plant will need to be added to the US electrical power system between 2010 and 2030, just "to keep the lights on". The overall cost is estimated at US$560 billion, but, if carbon capture and storage is required for new coal plants, then the bill would rise by an additional $200 billion. Modernising the transmission and distribution system, including the construction of new lines and substations, would add a further $900 billion by 2030. These figures do not include the costs of replacing every utility's entire computer system, which would be necessary to make the grid "fully smart", nor the costs of electric car recharging stations and other technologies needed to store electricity. The final price tag for such technologies is unknown, but according to Peter Fox-Penner, one of the report's authors, "it would likely cost hundreds of billions more and wouldn't be ready until sometime after 2030". If the electricity generated is to be entirely from "cleaner" (note "cleaner", not "clean") energy sources, the bill would be an estimated $2 trillion. More would be needed to shift US electricity production away from fossil fuels. Google has calculated that reducing fossil fuel-based electric generation by 88 percent by 2030 would require a net investment of $3.8 trillion in undiscounted 2008 dollars, although others give a lower estimate.

   See Google, "Clean Energy 2030", http://googleblog.blogspot.co.uk/2008/10/clean-energy-2030.html; Ken Berlin, Reed Hundt, Mark Muro, and Devashree Saha, *State Clean Energy Finance Banks: New Investment Facilities for Clean Energy Deployment*, Brookings-Rockefeller Project on State and Metropolitan Innovation, 2012, http://www.brookings.edu/~/media/research/files/papers/2012/9/12%20state%20energy%20investment%20muro/12%20state%20energy%20investment%20muro.pdf.

7. For ways of visualising a trillion dollars, *see* http://www.peakprosperity.com/crashcourse/chapter-11-how-much-trillion

8. World Economic Forum, *The Green Investment Report — The Ways and Means to Unlock Private Finance for Green Growth*, A Report of the Green Growth Action Alliance, 2013, p.13, "Table 1.1: Annual estimated investments needed under a business-as-usual and low-carbon scenario (US$ billions per year between 2010 and 2030)", http://www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf

   If projected investment needs in agriculture, transport, power and water are also included, the World Economic Forum estimates, US$100 trillion would be required between 2010 and 2030, under a "business-as-usual" scenario. With climate consideration taken into account, the figure would be $113.7 trillion. The International Energy Agency (IEA) gives a higher figure, estimating that from 2011 to 2035, over $35.6 trillion will need to be invested in energy supply infrastructure in order to meet climate goals.

   See The International Energy Agency, *World Energy Outlook 2011*, http://www.iea.org/publications/freepublications/publication/WEO2011_WEB.pdf. For other estimates, *see also* David Nelson and Brendan Pierpont, "The Challenge of Institutional Investment in Renewable Energy", Climate Policy Initiative, 2013, http://climatepolicyinitiative.org/wp-content/uploads/2013/03/The-Challenge-of-Institutional-Investment-in-Renewable-Energy.pdf.

9. World Economic Forum, *The Green Investment Report — The Ways and Means to Unlock Private Finance for Green Growth*, A Report of the Green Growth Action Alliance, 2013, p.15, http://www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf

10. Mark Z. Jacobson and Mark A. Delucchi, "A Plan to Power 100 Percent of the Planet with Renewables", *Scientific American*, 15 June 2010, http://www.scientificamerican.com/article.cfm?id=a-path-to-sustainable-energy-by-2030.

For other studies of the costs of energy transitions, *see*: International Energy Agency, *World Energy Outlook 2011*, http://www.iea.org/publications/freepublications/publication/WEO2011_WEB.pdf; European Commission, "A Roadmap for moving to a competitive low carbon economy in 2050", 8 March 2011, p.10, http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf;
Ingrid Holmes, Jonathan Gaventa, Nick Mabey and Shane Tomlinson, "Financing the Decarbonisation of European Infrastructure – 30 Percent and Beyond", E3G, June 2012, p.30, http://www.e3g.org/docs/E3G_Financing_the_Decarbonisation_of_European_Infrastructure.pdf;
"EPRI Does the Math on Total Smart Grid Cost (and It's a Lot)", *SmartGridNews.com*, 7 April 2011, http://www.smartgridnews.com/artman/publish/news/EPRI-does-the-math-on-total-smart-grid-cost-and-it-s-a-lot-3604.html#.UnpvRyeeVOx

11. Alf Hornborg, *The Power of the Machine: Global Inequalities of Economy, Technology and Environment*, Rowman & Littlefield, 2001, p.1.

12. COSATU*, Policy Framework on Climate Change: Adopted by the COSATU Central Executive Committee, August 2011,* http://www.cosatu.org.za/docs/policy/2011/pol1119.html

13. Keynote Address to African National Congress National Meeting on Electrification, University of Cape Town 1992, cited in Theron, Paul (ed.), *Proceedings of the ANC National Meeting on Electrification*, University of Cape Town, February 1992, published by African National Congress, Department of Economic Planning/Centre for Development Studies 1992.

14. Greenpeace, *Energy [R]evolution 2012*, http://www.greenpeace.org/international/Global/international/publications/climate/2012/Energy%20Revolution%202012/ER2012.pdf; World Wide Fund for Nature/Ecofys, *The Energy Report 2011: 100 Per Cent Renewable Energy by 2050*, WWF, Gland, Switzerland, 2011, p.7, http://assets.panda.org/downloads/the_energy_report_lowres_111110.pdf

15. Bank for International Settlements, "Table 19: Amounts outstanding of over-the-counter (OTC) derivatives", *Derivatives Statistics*, 7 November 2013, http://www.bis.org/statistics/dt1920a.pdf

16. *See* the work of the Centre for Economic, Social and Cultural Change (CRESC), http://www.cresc.ac.uk/

17. Anthropologist David Graeber reports hearing this view from a well-educated anti-poverty campaigner in London. *Debt: The First 5,000 Years,* Melville House, New York, 2012.

18. International Energy Agency, *World Energy Outlook – Access to Energy*, http://www.worldenergyoutlook.org/resources/energydevelopment/accesstoelectricity/

19. "Call for Action: Power 4 People", http://www.internationalrivers.org/campaigns/power-4-people.

20. Matthew Paterson and Peter Newell, "Of Heroes, Villains and Climate Capitalism: A Response to Larry Lohmann", *Development and Change,* Vol. 43, No. 5, 2012, pp.1171-75.

21. Comments from Victor Anderson (formerly WWF, now Angela Ruskin University) on Sian Sullivan, "Financialization, Biodiversity Conservation and Equity: Some Currents and Concerns", Third World Network, Penang, 2012, n.d.

22. The phrase "nonreformist reforms" is due to Andre Gorz.

23. This approach, captured in the Zapatista slogan "while changing the world is very difficult, perhaps impossible, it is possible to create a whole new world", is rooted in an activism that refuses to accept the political space it operates in as a given; that views "participating" in processes that rely on existing power structures as less fruitful than tilling new ground where different relations of power can be forged; that recognizes that structural transformation is nigh on impossible if it relies on the good will of existing institutions to implement change; and that seeks to forge structural change in the realm of everyday action and the relationships such action builds and re-builds.

24. Liane Schalatek, "A Matter of Principles", Heinrich Boll Foundation, Berlin, 2010, p.9. Such principles, this treatise asserts, are the "fundamental . . . compass for charting policy responses to climate change that are rooted in the concept of justice and fairness, especially with respect to evaluating the financial architecture necessary to fund sustainable and efficient climate interventions globally". The booklet proclaims itself ready to identify "pitfalls", but does not investigate the practical question of how money or finance actually works.

25. G. K. Chesterton, *Eugenics and Other Evils*, London, 1917.

26. Carbon Tracker, "Unburnable Carbon: Wasted Capital and Stranded Assets 2013", http://www.carbontracker.org/wastedcapital.

27. "MBD's Divide-and-Conquer Strategy to Defeat Activists," *PR Watch*, Vol. 1, No. 1, 1993, pp.5-6; Greg Muttit, *Fuel on the Fire: Oil and Politics in Occupied Iraq*, Verso, London, 2012.

    The slogan of one such NGO, Washington's Environmental Defense Fund, is, ironically, "finding the ways that work". Without a trace of ironic self-awareness, EDF, with a current budget of over $100 million per year, recently listed its top achievement over 46 years of work as having once served as an unpaid assistant to the giant transnational corporation McDonalds in its phaseout of "clamshell" plastic sandwich containers. In greater detail, EDF's self-defence consisted of the following: "In 1991, we helped McDonald's phase out foam 'clamshell' sandwich containers. In 2004, EDF and FedEx launched the first 'street-ready' hybrid trucks ever built. Today, hybrids are in hundreds of corporate fleets, from UPS to Coca-Cola to the U.S. Postal Service. And since 2008, EDF's Climate Corps program has placed hundreds of MBAs at some of the biggest corporations in the world to both increase energy efficiency today and train them as business leaders of tomorrow. To date, our Climate Corps fellows have identified $1.2 billion in potential energy savings, with greenhouse gas reductions equivalent to taking 200,000 cars off the road." EDF also presented the

damage it has done through promoting carbon trading legislation worldwide as if it were an "achievement" by falsely claiming that "the EU's cap-and-trade system has driven significant reductions in greenhouse gas emissions, even during periods of economic growth". It is perhaps not surprising that Eric Pooley, the EDF vice-president, can defend such a record only by citing "diversity" and "ideology-free ideas": "Great ideas can sprout up anywhere across the spectrum of the environmental community" (http://thinkprogress.org/climate/2013/09/11/2604391/viewpoint-naomi-klein/).

28. Robin Hahnel, "Desperately Seeking Left Unity on International Clilmate Policy", *Capitalism Nature Socialism*, Vol 23, No. 4, pp.83-99, p.95.

29. Carbon offsets equate above-ground and below-ground carbon and equate counterfactual history and actual history, in addition to relying on measurement apparatus that does not exist. *See*, e.g., Larry Lohmann (ed.), *Carbon Trading*, Dag Hammarskjold Foundation, Uppsala, 2006.

30. Other necessary conditions for carbon markets that have not been achieved, or are unachievable, include auctioned rather than grandfathered allowances, workable "forest governance" structures worldwide, globally-omnipresent citizen watchdogs, and uncaptuable regulators.

31. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity*, University of California Press, Berkeley, 1992, p.46.

32. Alf Hornborg, *Global Ecology and Unequal Exchange: Fetishism in a Zero-Sum World,* Routledge, New York, 2012; *The Power of the Machine: Global Inequalities of Economy, Technology and Environment,* AltaMira, Walnut Creek, 2001.

33. Ivan Illich, *Energy and Equity*, Calder and Boyars, London, 1974; "The Social Construction of Energy", *New Geographies* 2, 2009 [1983], pp.11-19.

34. Elmar Altvater, *The Future of the Market: An Essay on the Regulation of Money and Nature after the Collapse of 'Actually Existing Socialism',* Verso, London, 1993.

35. Nicholas Hildyard, "Infrastructure as an Asset Class: Financing Development or Developing Finance?", *Bretton Woods Update*, 3 July 2012, http://www.brettonwoodsproject.org/wp-content/uploads/2014/02/bwupdt81_ai.pdf.

36. *See* www.eia.gov and www. worldbank.org for more complete figures.

37. Raymond Williams, *Keywords: A Vocabulary of Culture and Society*, Croom Helm, London, 1976, p.16.

38. Richard Heinberg, *Searching for a Miracle: Net Energy Limits and the Fate of Industrial Society*, International Forum on Globalization and the Post Carbon Institute, 2009, http://www.postcarbon.org/new-site-files/Reports/Searching_for_a_Miracle_web10nov09.pdf, p.12.

39. James McKay and Benjamin Dickson, *Dreams of a Low Carbon Future*, University of Leeds, 2013, pp.9, 11, 13.

40. Raymond Williams, *Keywords: A Vocabulary of Culture and Society*, Croom Helm, London, 1976, p.16.

41. Thomas Kuhn, "Energy Conservation as an Example of Simultaneous Discovery" in *The Essential Tension: Selected Studies in Scientific Tradition and Change*, Chicago, 1977.

42. Theodore M. Porter, "Rigour and Practicality: Rival Ideals of Quantification in Nineteenth-Century Economics", *in* Philip Mirowski, *Natural Images in Economic Thought*, Cambridge University Press, Cambridge, 1994, pp.128-170, p.141.

43. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity*, University of California Press, Berkeley, 1992, p.45.

44. Paul Mantoux, *The Industrial Revolution in the 18th Century*, Harper and Row, New York, 1962, p.376.

45. Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain,* University of Chicago Press, Chicago, 1999, pp.39-40.

46. Ibid., pp.55-56, 151.

47. Ibid., p.54, emphasis added.

48. Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production", *Review of Radical Political Economics,* Vol. 6, No. 2, 1974, pp.60–112, p.62.

49. Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain*, University of Chicago Press, Chicago, 1999, p.128.

50. Matthew T. Huber, *Lifeblood: Oil, Freedom and the Forces of Capital*, University of Minnesota Press, Minneapolis, 2013, p.11.

51. John Bellamy Foster, Brett Clark and Richard York, *The Ecological Rift: Capitalism's War on the Earth*, Monthly Review Press, New York, 2011, p.310.

52. Theodore M. Porter, "Rigour and Practicality: Rival Ideals of Quantification in Nineteenth-Century Economics", *in* Philip Mirowski, *Natural Images in Economic Thought*, Cambridge University Press, Cambridge, 1994, pp.128-170, p.143.

53. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity*, University of California Press, Berkeley, 1992; *see also* Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, London, 2011, p.104.

54. Robert D. Kaplan, "The Coming Anarchy," *Atlantic Monthly*, Vol. 273, No. 2 (February 1994):44-76; *see* Larry Lohmann, "Malthusianism and the Terror of Scarcity", http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/Terror.pdf

55. One 18th-century British financier who set up a workshop with hand-powered equipment in anticipation of finding a suitable water mill wrote that "I have not half my people come to work today, and I have no great fascination in the prospect I have to put myself in the power of such people." Discipline did not improve with mechanization. A visitor found that "only four frames were regularly at work, since there were seldom hands enough." (quoted in Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production", *Review of Radical Political Economics,* Vol. 6, No. 2, 1974, pp.60–112, p.86).

One businessman of the mid-18th century complained

that workers "who can subsist on three days work will be idle and drunken the remainder of the week . . . The poor in the manufacturing counties will never work any more time in general than is necessary just to live and support their weekly debauches . . . We can fairly aver that a reduction of wages in the woolen manufacture would be a national blessing and advantage, and no real injury to the poor. By this means we might keep our trade, uphold our rents, and reform the people into the bargain" (Smith, *Memoirs of Wool*, 1747, quoted in E. P. Thompson, *The Making of the English Working Class*, Penguin, London, 1963, p.277).

56. Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production", *Review of Radical Political Economics*, Vol. 6, No. 2, 1974, pp.60–112, p.93

57. Andrew Ure, *Philosophy of Manufactures*, quoted in Marglin, op. cit., pp.84-5.

58. George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013, p.13.

59. Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, London, 2011, p.77.

60. Thomas Kuhn, "Energy Conservation as an Example of Simultaneous Discovery" in *The Essential Tension: Selected Studies in Scientific Tradition and Change*, Chicago, 1977, p.78.

    The British polymath Thomas Young had applied the word "energy" to an older concept, *vis viva*, in 1807. *Vis viva*, a mechanical concept, had been introduced much earlier by mathematician and philosopher Gottfried Leibniz, who claimed it was conserved not only when bodies collided but also throughout the universe. But neither Leibniz nor Young considered the conversion of *vis viva* into heat, or vice versa; Young's "energy" was not yet thermodynamic energy, or what this report calls Big-E Energy. *See* Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain*, Chicago, 1998, p.36.

61. Jean Robert, "Alternatives and the Technogenic Production of Scarcity", *New Geographies* 2, 2009, pp.134-38, p.135.

62. Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity*, University of California Press, Berkeley, 1992, p.69. In philosopher Ivan Illich's colourful formulation, energy became "nature's ultimate Kapital . . . By a cosmic extension of the assumption of scarcity, the world visible and invisible was turned into a zero-sum game, as if Jehovah, with a big bang, had created das Kapital" ("The Social Construction of Energy", *New Geographies* 2, 2009).

63. Kenneth Pomerantz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy,* Princeton University Press, Princeton, 2001.

64. George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013, p.14.

65. Karl Marx, *Capital*, vol. I, trans. Ben Fowkes, Penguin, London, 1990 [1867], p.545.

66. Ibid., p.534.

67. Vaclav Smil, *Energy in World History*, Westview, Boulder, 1994, p.194; *see also* David E. Nye, *Electrifying America: Social Meanings of a New Technology 1880-1940,* MIT Press, 1992.

68. David F. Noble, *Forces of Production: A Social History of Industrial Automation,* Oxford University Press, 1986.

69. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, p.112.

70. Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the 19th Century*, University of California Press, 1987.

71. William Pietz, "The Problem of the Fetish", *RES: Anthropology and Aesthetics* 9, 1985, pp.5-17; *RES: Anthropology and Aesthetics*13, 1987, pp.23-45; *RES: Anthropology and Aesthetics*16, 1988, pp.105-124.

72. *See also* The Corner House, *Energy Security: For What? For Whom?*, Sturminster Newton, Dorset, 2012, http://www.thecornerhouse.org.uk

73. Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, p.108.

74. Alf Hornborg, *The Power of the Machine: Global Inequalities of Economy, Technology and Environment*, AltaMira, Walnut Creek, 2001, p.95.

75. Matthew Huber, "Energizing Historical Materialism: Fossil Fuels, Space and the Capitalist Mode of Production", *Geoforum*, Vol. 40, No. 1, 2006, pp.105-115, is worth quoting at length: ". . . the generalization of capitalist production depended on historical processes of 'proletarianization', or divorcing the mass of the productive population from any means of producing a livelihood themselves (most importantly, land); a history 'written in letters of blood and fire' … the famous [British] Poor Law Reforms of 1834 did away with the 'right to live' and established for the first time a labour market 'on a national scale'. In [economic historian Karl] Polanyi's view, this was crucial to the requirements of an industrial economy where starvation and pauperism provided the basis through which a 'reserve army' of unemployed could provide the check against wage-worker autonomy, power and control . . . The historical emergence of the social relation of wage labour is thus part and parcel of the 'energy shift' in the productive forces from biological to inanimate (fossil) sources of energy. My point is not that the social relation of wage labour cannot exist without the displacement of human muscle power, but rather the emergence of large-scale fossilized production hastened the generalization and extension of the wage labour relationship on an expanded scale heretofore unseen. In previous modes of production, such as feudalism, wage labour might have been one amongst many competing modes of labour (slavery or serfdom), while most social conflict centered upon the control and access over land and labour and the concentrated fruits of solar energy. The generalization of wage labour is predicated upon industrial capital's peculiarly mammoth levels of productivity . . . it is not simply the presence of wage labour that connotes the emergence of industrial capitalist development, but an epochal development of the productive forces as well. In the case of fossil-powered industry, 'nature', or the many millions of years it takes to form fossil deposits, can be conceptualized as a crucial aspect of the original conceptual distinction between the formal and real subsumption of labour."

76. Anastassia Makarieva, Victor G. Gorshkov and Bai-Lin Li, "Energy Budget of the Biosphere and Civilization: Rethinking Environmental Security of Global Renewable and Non-Renewable Resources", *Ecological Complexity* Vol. 5, No. 4, 2008, pp.281–288.

77. Elmar Altvater, *The Future of the Market: An Essay on the Regulation of Money and Nature after the Collapse of 'Actually Existing Socialism',* Verso, London, 1993; Michael Hudson, *The Bubble and Beyond: Fictitious Capital, Debt Deflation and Global Crisis*, Islet, 2012.

78. Paul Mattick, *Business as Usual: The Economic Crisis and the Failure of Capitalism,* Reaktion Books, London, 2011.

79. Matthew T. Huber, *Lifeblood: Oil, Freedom and the Forces of Capital*, University of Minnesota Press, Minneapolis, 2013.

80. Jeffrey S. Dukes, "Burning Buried Sunshine: Human Consumption of Ancient Solar Energy", *Climatic Change* 61, pp.31–44, 2003.

81. George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013, p.14.

82. Alf Hornborg, "Machine Fetishism, Value, and the Image of Unlimited Good: Towards a Thermodynamics of Imperialism", *Man*, Vol. 27, No. 1 (Mar., 1992), pp.1-18, 1992, p.7.

83. Alf Hornborg, *Global Ecology and Unequal Exchange: Fetishism in a Zero-Sum World,* Routledge, New York, 2012.

84. As US historian Henry Adams worriedly put it around the time of the First World War: "Man dissipates every year all the heat stored in a thousand million tons of coal which nature herself cannot now replace, and he does this only in order to convert some ten or fifteen per cent of it into mechanical energy immediately wasted on his transient and commonly purposeless objects" (*The Education of Henry Adams*, New York, 1918).

85. While world GDP would virtually disappear without fossil fuel inputs, only 5-10 per cent of that GDP consists of energy costs.

86. Alf Hornborg, "Zero-Sum World: Challenges in Conceptualizing Environmental Load Displacement and Ecologically Unequal Exchange in the World-System", *International Journal of Comparative Sociology,* Vol. 50, Nos. 3–4, pp.237–262, p.248.

87. Alf Hornborg, *The Power of the Machine: Global Inequalities of Economy, Technology and Environment*, AltaMira, Walnut Creek, 2001, p.45.

88. Andreas Malm, "The Origins of Fossil Capital: From Water to Steam in the British Cotton Industry", *Historical Materialism*, Vol. 21, No. 1, 2013, pp.15–68, p.52, emphasis added.

89. Alf Hornborg, *The Power of the Machine: Global Inequalities of Economy, Technology and Environment*, AltaMira, Walnut Creek, 2001, p.129. It is "impossible to understand the expansion of unsustainable technological systems without reference to unequal global exchange" (p.55) and impossible to disentangle "net energy transfers and class divisions" (Stephen G. Bunker and Paul S. Ciccantell, *Globalization and the Race for Resources,* Johns Hopkins University Press, Baltimore, 1985).

90. Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, pp.105-08, *see also* Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.134.

91. Elihu Root, President Theodore Roosevelt's Secretary of State, quoted in Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.45.

92. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.135.

93. Jean Robert, "Alternatives and the Technogenic Production of Scarcity", *New Geographies* 2, 2009, pp.134-38.

94. Karin Zimmermann, "Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures" *in* Nina Mollers, Karin Zachmann (eds.), *Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures*, Transcript Verlag Bielefeld, 2012, pp.12-13; *see also* Joan Martinez-Alier, *Ecological Economics: Energy, Environment and Society*, Blackwell, Oxford, 1987, pp.127-48.

95. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.221.

96. Quoted in Karin Zimmermann, "Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures" *in* Nina Mollers, Karin Zachmann (eds.), *Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures*, Transcript Verlag Bielefeld, 2012.

97. Larry Lohmann, "Malthusianism and the Terror of Scarcity", http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/Terror.pdf

98. Peter Kriedte, Hans Medick and Jurgen Schlumbohm, *Industrialization before Industrialization*, Cambridge University Press, Cambridge, 1982.

99. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, pp.52-3.

100. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.59.

101. Karl Marx, *Capital*, vol. I, trans. Ben Fowkes, Penguin, London, 1990 [1867], p.499, emphasis added.

102. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.102.

103. Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, p.60.

104. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.104.

105. Ibid., p.114.

106. Ibid., p.139.

107. Roger Stern, "United States Cost of Military Force Projection ih the Persian Gulf, 1976-2007", *Energy Policy* 38, 2010, pp.2816-25.

108. Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880-1930,* Johns Hopkins University Press, Baltimore, 1993.

109. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.134.

110. James Allen Jaffe, *The Struggle for Market Power,* Cambridge 1991, p.13.

111. Size is calculated by revenue. *See* http://money.cnn.com/magazines/fortune/global500/2012/full_list/

112. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.179.

113. Data taken from Google Ngram.

114. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991.

115. Nina Mollers, Karin Zachmann (eds.), *Past and Present Energy Societies: How Energy Connects Politics, Technologies and Cultures*, Transcript Verlag Bielefeld, 2012.

116. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991.

117. Beverly Duncan and Stanley Lieberson, *Metropolis and Region in Transition*, Sage, Beverly Hills, 1970.

118. Matthew T. Huber, *Lifeblood: Oil, Freedom and the Forces of Capital*, University of Minnesota Press, Minneapolis, 2013, p.xv.

119. Ibid., pp.17-8; *see also* Mike Davis, *Prisoners of the American Dream*: *Politics and Economy in the History of the United States Working Class,* Verso, London, 1986.

120. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991.

121. Ibid., p.136. *See also* Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, p.62.

122. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.137.

123. Ibid., p.136.

124. Ibid. Global oil output roughly doubled every ten years between 1870 and 1970.

125. Bryan Pfaffenberger, "Fetishised Objects and Humanised Nature: Towards an Anthropology of Technology", *Man*, Vol. 23, No. 2, 1988, pp.236-252, p.249.

126. Karl Marx, *Capital*, vol. I, trans. Ben Fowkes, Penguin, London, 1990 [1867], p.503.

127. Silvia Federici, *Caliban and the Witch: Women, the Body and Primitive Accumulation*, Autonomedia, Brooklyn, 2004.

128. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.117; Andrew Ure, *The Philosophy of Manufactures*, 1835.

129. Frederick Winslow Taylor, *The Principles of Scientific Management,* Harper and Brothers, New York, 1911.

130. Graham Zabel, "Peak People: The Interrelationship between Population Growth and Energy Resources", *Energy Bulletin*, 20 April 2009, at energybulletin.net/node/48677.

131. Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, 2011, London.

132. *See*, e.g., Julian E. Orr, *Talking about Machines: An Ethnography of a Modern Job*, Cornell University Press, Ithaca, 1996.

133. Karl Marx, *Capital*, vol. I, trans. Ben Fowkes, Penguin, London, 1990 [1867], p.352.

134. Moise Postone, *Time, Labour and Social Domination: A Re-Interpretation of Marx's Critical Theory*, Cambridge University Press, Cambridge, p.298.

135. Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, London, 2011, p.140.

136. The cyborg metaphor also features what will surely prove in future contexts to be misleading aspects. Yet in addition to resisting the fetishization of a human organism that stops at the skin, it has the present virtue of militating against Cartesianism, the tendency to assimilate tools to machines, the slave metaphor that says that the machine is something separate "at the service of" an essentialized human (*see* Box: "Does Energy Really Save Labour? Is Energy Really a 'Slave'?"), various kinds of technophobia, and what philosopher Amy Wendling calls "capitalist humanism" (Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, London, 2011). It suggests that the question is not how to defend an essentialized human against contamination from "outside", but rather what kind of symbiosis there is to be.

137. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.142.

138. Karl Marx, *Grundrisse,* Pelican, London, 1973, p.769.

139. *See* Matthew T. Huber, *Lifeblood: Oil, Freedom and the Forces of Capital*, University of Minnesota Press, Minneapolis, 2013; David Graeber, *Debt: The First 5,000 Years,* Melville House, New York, 2012; and Matt Taibbi, *Griftopia: A Story of Bankers, Politicians, and the Most Audacious Power Grab in American History,* Spiegel and Grau, 2011.

    David Graeber comments: "Everyone could now have political rights – even, by the 1990s, most everyone in Latin America and Africa – but political rights were to become economically meaningless. The link between productivity and wages was chopped to bits: productivity rates have continued to rise, but wages have stagnated or even atrophied: not to say that the people of the world were not being offered something: just that … the terms had changed. In the new dispensation, wages would no longer rise, but workers were encouraged to buy a piece of capitalism. Rather than eutha-

nize the rentiers [an approach John Maynard Keynes had jokingly advocated], everyone could now become rentiers – effectively, could grab a chunk of the profits created by their own increasingly dramatic rates of exploitation, mortgage-refinancing schemes that treated houses, whose value it was assumed would only rise, 'like ATMs'. For many, "buying a piece of capitalism" slithered undetectably into something indistinguishable from those familiar scourges of the working poor: the loan shark and the pawnbroker" (p.376).

140. Huber, op. cit., pp.31-32; *see also* Randy Martin, *Financialization of Daily Life*, Temple University Press, Philadelphia, 2002.

141. Huber, op. cit., p.16.

142. Jason W. Moore, "Transcending the Metabolic Rift: A Theory of Crises in the Capitalist World-Ecology", *Journal of Peasant Studies*, Vol. 38, No. 1, 2011, pp.1-46.

143. *See* the discussion touched off by Robert Brenner, "Agrarian Class Structure and Economic Development in Pre-Industrial Europe, *Past and Present* 70, 1976.

144. Jason W. Moore, "The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010", *Journal of Agrarian Change*, Vol. 10, No. 3, 2010, pp.389-413.

145. The concept of "food regimes" is due to Harriet Friedmann.

146. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.185.

147. Jason W. Moore, "The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010", *Journal of Agrarian Change*, Vol. 10, No. 3, 2010, pp.389-413.

148. Kim Moody, *Workers in a Lean World: Unions in the International Economy,* Verso, London, 1997, p.88.

149. Tony Weis, *The Global Food Economy*, Zed, London, 2007.

150. Camila Moreno, personal communication.

151. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, pp.79-81.

152. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991.

153. Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, p.151. The shift occurred earlier in the US than in Europe.

154. Ibid.

155. Patrick Canning, Ainsley Charles, Sonya Huang et al., *Energy Use in the US Food System*, Economic Research Report No. 94, United States Department of Agriculture, Washington, DC, 2010, http://www.ers.usda.gov/media/136418/err94_1_.pdf.

156. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.48.

157. Paul Bairoch, *Economics and World History: Myths and Paradoxes*, University of Chicago Press, Chicago, 1993, p.156.

158. *See*, e.g., David Pimentel, S. Williamson, C.D. Alexander et al, "Reducing Energy Inputs in the US Food System", *Human Ecology* 36, 2008, pp.459-71; Joan Martinez-Alier, "The EROI of Agriculture and Its Use by the Via Campesina", *Journal of Peasant Studies*, Vol. 38, No. 1, 2011, pp.145-160.

159. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012.

    The energy return from corn or sugar plants raised for agrofuels is often actually negative when compared to the energy input. This imbalance is so severe that, as geographer David Harvey points out, "we are currently re-creating the barriers to capital accumulation that the shift to fossil fuels in the late eighteenth century so successfully circumvented by revolutionizing the relation to nature" (David Harvey, *A Companion to Marx's Capital*, Verso, London, 2010).

160. And less sense still than hunting and gathering in many locations. Only from a geographically- and temporally-restricted perspective can an industrial plantation appear "efficient", or most "economies of scale" anything more than an artifact of analytical exclusions.

161. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, pp.66, 81.

162. The influence of finance in reinforcing the dynamic of cyborg plants and animals seeking out uncapitalized regions of extra-human nature is also evident in the tendency toward farm concentration, both in Northern countries such as the US and in Southern nations now subject to international "land grabs". By 2004, just 3.4 per cent of US farms produced over 45 per cent of output by value, close to doubling the output share of the largest farms in the 1970s. *See* Jason W. Moore, "The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010", *Journal of Agrarian Change*, Vol. 10, No. 3, 2010, pp.389-413.

163. *See*, e.g., Morgan M. Robertson, "Measurement and Alienation: Bringing Ecosystems to Market", *Transactions of the Institute of British Geographers,* Vol. 37, No. 3, 2012, pp.386–401; Morgan M. Robertson, "Discovering Price in All the Wrong Places: Commodity Definition and Price under Neoliberal Environmental Policy", *Antipode*, Vol. 39, No. 3, 2007, pp.500-526; Morgan M. Robertson, "The Nature that Capital Can See: Science, State and Market in the Commodification of Ecosystem Services", *Environment and Planning D: Society and Space*, Vol. 24, No. 3, 2006, pp.367-387.

164. W. Boyd, W. Prudham and R. Schurman, "Industrial Dynamics and the Problem of Nature", *Society and Natural Resources* 14, 2001, pp.631-64; Neil Smith, "Nature as Accumulation Strategy", in *Coming to Terms with Nature: Socialist Register 2007,* 2006, pp.16-36.

165. Jason W. Moore, "The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010", *Journal of Agrarian Change*, Vol. 10, No. 3, 2010, pp.389-413.

    In a supplement to the tendency of the rate of profit to fall in industry, and the tendency of a growing "tech-

nomass" (like a maturing rainforest) to decline in net productivity because of rising energy requirements for maintenance, the "capitalization of world nature tends to rise faster than the opportunities for appropriation, reducing the ecological surplus", leading to "rising costs of production in agriculture, energy production and other primary sectors. This can be counteracted, Moore writes, only by liberating new reservoirs of "socialized natures" – rivers, natural gas fields, peasant societies – for the accumulation process. "The relative ecological surplus falls as the capitalization of global nature proceeds," Moore goes on to suggest that while biotechnology and biopiracy through various "new enclosures" may have succeeded in greasing the wheels of world accumulation since the 1990s, they have "done little to achieve what all previous agricultural revolutions had done: create the conditions for a long-term relative decline in food prices." "There is little to suggest," Moore concludes, "that China is on the brink of an agricultural revolution that will not only feed the world, but lead capitalism to a new golden age."

166. *See* http://www.etcgroup.org.

167. *See*, e.g., Stephen Gudeman and and Alberto Rivera, *Conversations in Colombia: The Domestic Economy in Life and Text,* Cambridge University Press, Cambridge, 1990.

168. Quoted in Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.90.

169. *See*, e.g., Tania Li, "Centering Labour in the Land Grab Debate", *Journal of Peasant Studies*, Vol. 38, No. 2, 2011, pp.281-98.

170. Baseline communism, David Graeber writes, invariably kicks in at an even more basic level than that of the commons principles that permeate capitalism and other institutional systems – that is, at the level of even more "immediate and practical questions of who has access to what sorts of things and under what conditions": "Almost everyone follows [the] principle 'from each according to their abilities, to each according to their needs' if they are collaborating on some common project. If someone fixing a broken water pipe says, 'Hand me the wrench,' his co-worker will not, generally speaking, say, 'And what do I get for it?' – even if they are working for Exxon-Mobil, Burger King, or Goldman Sachs. The reason is simple efficiency (ironically enough, considering the conventional wisdom that 'communism just doesn't work'): if you really care about getting something done, the most efficient way to go about it is obviously to allocate tasks by ability and give people whatever they need to do them. One might even say that it's one of the scandals of capitalism that most capitalist firms, internally, operate communistically . . . The greater the need to improvise, the more democratic the cooperation tends to become. Inventors have always understood this, start-up capitalists frequently figure it out, and computer engineers have recently rediscovered the principle: not only with things like freeware, which everyone talks about, but even in the organization of their businesses . . . communism is the foundation of all human sociability. It is what makes society possible. There is always an assumption that anyone who is not actually an enemy can be expected on the principle of 'from each according to their abilities,' at least to an extent: for example, if one needs to figure out how to get somewhere, and the other knows the way . . . it's rather difficult to refuse [a cigarette or a light to a fellow smoker] such a request. In such cases – a match, a piece of information, holding the elevator – one might say the 'from each' element is so minimal that most of us comply without even thinking about it. Conversely, the same is true if another person's need – even a stranger's – is particularly spectacular or extreme: if he is drowning, for example. If a child has fallen onto the subway tracks, we assume that anyone who is capable of helping her up will do so" (David Graeber, *Debt: The First 5,000 Years*, Melville House, New York, 2011).

171. Silvia Federici, *Caliban and the Witch: Women, the Body and Primitive Accumulation*, Autonomedia, Brooklyn, 2004, p.156.

172. David Graeber, "Turning Modes of Production Inside Out: Or, Why Capitalism is a Transformation of Slavery (short version)", *Critique of Anthropology*, Vol. 26, No. 1, 2006, pp.61-81.

173. Ivan Illich, *Shadow Work*, Marion Boyars, London, 1981, p.101.

174. *See*, e.g., Viviana Zelizer, *The Social Meaning Of Money: Pin Money, Paychecks, Poor Relief and Other Currencies,* Basic Books, New York, 1995.

175. Paul Burawoy, *Manufacturing Consent: Changes in the Labour Process Under Monopoly Capitalism,* University of Chicago Press, Chicago, 1980; Paul Willis, *Learning To Labour,* Ashgate, Aldershot, 1977; Gerd Spittler, "Contesting the Great Transformation: Work in Comparative Perspective", *in* Chris Hann and Keith Hart (eds.), *Market and Society: The Great Transformation Today*, Cambridge University Press, Cambridge, 2009, pp.160-74; Slavoj Zizek, *The Plague of Fantasies*, Verso, London, 1997.

176. Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain*, University of Chicago Press, Chicago, 1999.

177. In the extreme case, the planner's "discovery" or rediscovery may bring about a far-reaching shift of orientation that throws the contradiction into especially sharp relief. One example is the (forced) rediscovery and revaluation of organic, urban or community agriculture in Cuba following the withdrawal of the fossil subsidy at the time of the collapse of the Soviet Union.

178. The villager is likely to understand, somewhat better than an average middle-class European, that, to borrow the words of anthropologist David Graeber, no system will ever be possible "in which everyone who wasn't a capitalist was somehow able to become a respectable, regularly-paid wage laborer with access to adequate dental care. A world like that has never existed and never could exist. What's more, the moment that even the prospect that this might happen begins to materialize, the whole system starts to come apart" (David Graeber, *Debt: The First 5,000 Years*, Melville House, New York, 2011, p.355). This is the meaning of the ubiquitous retort of the dispossessed throughout the South to the state or corporation dispossing them: "Where would you have us go?"

In the neoliberal era, of course, this truth has become better known in Europe as well: "When the Keynesian settlement was finally put into effect, after World War II, it was offered only to a relatively small slice of the world's population. As time went on, more and more people wanted in on the deal. Almost all of the popular movements of the period from 1945 to 1975, even perhaps revolutionary movements, could be seen as

demands for inclusion: demands for political equality that assumed equality was meaningless without some level of economic security. This was true not only of movements by minority groups in North Atlantic countries who had first been left out of the deal – such as those for whom Dr. King spoke – but what were then called 'national liberation' movements from Algeria to Chile, or, finally, and perhaps most dramatically, in the late 1960s and 1970s, feminism. At some point in the 1970s, things reached a breaking point. It would appear that capitalism, as a system, simply cannot extend such a deal to everyone. Quite possibly it wouldn't even remain viable if all its workers were free wage laborers; certainly it will never be able to provide everyone in the world the sort of life lived by, say, a 1960s auto worker in Michigan or Turin with his own house, garage, and children in college – and this was true even before so many of those children began demanding less stultifying lives . . . By the late 1970s, the existing order was clearly in a state of collapse, plagued simultaneously by financial chaos, food riots, oil shock, widespread doomsday prophecies of the end of growth and ecological crisis – all of which, it turned out, proved to be ways of putting the populace on notice that all deals were off . . . [W]hen both Ronald Reagan in the United States and Margaret Thatcher in the UK launched a systematic attack on the power of labor unions, as well as on the legacy of Keynes, it was a way of explicitly declaring that all previous deals were off" (pp.374-75).

179. Compare Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity*, University of California Press, Berkeley, 2002, pp.244-71 on Egyptian farmers' use of deregulation and the market in their moves "toward increased self-provisioning and protection from the market".

180. Jean Robert, "Alternatives and the Technogenic Production of Scarcity", *New Geographies* 2, 2009, pp.134-38.

181. Ivan Illich, *Shadow Work*, Marion Boyars, London, 1981; Ivan Illich, *Gender*, Pantheon, New York, 1983; Richard Wilkinson and Kate Pickett, *The Spirit Level: Why Equality is Better for Everyone,* Penguin, London, 2010.

182. K. Shandling, "What Impact Will These Funds Have on the Water and Wastewater Infrastructure Sector?", *Water Utility Infrastructure Management*, 1 July 2007, http://www.uimonline.com/index/webapp-stories-action?id=29&archive=yes&Issue=2007-08-01

183. Nancy Fraser, "Behind Marx's 'Hidden Abode': Toward an Expanded Conception of Capitalism", Inaugural Manchester Lecture in Global Political Economy, Political Economy Institute, Manchester University, 13th February 2014.

184. Each subscriber to a tontine fund pays an agreed sum into the fund, thus becoming entitled to an annuity. As members die, their shares go to the other participants. The more members die off, the higher the annuities of living members become. On the death of the last member, the scheme is wound up.

185. The relationship of capital to worker-organized friendly societies was always ambivalent. On the one hand, the societies were viewed as a social good, in that they provided a safety net for the poor. But their use in times of strike was another matter – and one that early regulation sought to limit. *See* Peter Gosden, *The Friendly Societies in England 1815-1875*, Gregg Revivals, 1993.

186. Project finance is a form of debt finance in which banks lend money against the projected income of a project but have no recourse to the assets of the project developer in case of failure, other than those of the project itself and the income from the sale of its "off-take" or products.

187. Bethany McLean and Peter Elkind, *Enron: The Smartest Guys in the Room*, Portfolio Trade, 2004.

188. Gary Cohn, Testimony to Energy Summit Hearing, Committee on Energy and Natural Resources, United States Senate, 12 September 2008, p.85, http://www.gpo.gov/fdsys/pkg/CHRG-110shrg45837/pdf/CHRG-110shrg45837.pdf

189. Gillian Tett, *Fool's Gold: How Unrestrained Greed Corrupted a Dream, Shattered Global Markets and Unleashed a Catastrophe*, Little, Brown, New York, 2009, pp.54-55.

190. Christine Nielsen, "How Weather Derivatives Help Prepare For Financial Storms", *Openmarkets*, 6 December 2013, http://openmarkets.cmegroup.com/7356/how-weather-derivatives-help-prepare-businesses-for-financial-storms

191. Peter C. Fusaro and Gary M. Vasey, *Energy And Environmental Hedge Funds: The New Investment Paradigm*, J. Wiley and Sons, 2006, p.137.

192. Karl Marx, "The French Credit Mobilier", *New York Tribune*, 24 June 1856, http://marxengels.public-archive.net/en/ME0978en.html

193. Karl Marx, *Capital*, Vol. 3, 1894 edition, https://www.marxists.org/archive/marx/works/1894-c3/ch27.htm.

194. Ibid.

195. Dick Bryan and Michael Rafferty, *Capitalism with Derivatives: A Political Economy of Financial Derivatives, Capital and Class*, Palgrave Macmillan, New York, 2006, p.84.

196. Organization for Economic Co-operation and Development*, Annual Survey of Large Pension Funds and Public Pension Reserve Funds: Report on pension funds' long-term investments*, October 2013, p.10, http://www.oecd.org/daf/fin/private-pensions/LargestPensionFunds2012Survey.pdf

197. Louis D. Brandeis, *Other People's Money – and How the Bankers Use It*, http://www.law.louisville.edu/library/collections/brandeis/node/192

198. Edward LiPuma and Benjamin Lee, *Financial Derivatives and the Globalization of Risk*, Public Planet Books, Duke University Press, 2004.

199. Dick Bryan and Michael Rafferty, *Capitalism with Derivatives: A Political Economy of Financial Derivatives*, Capital and Class, Palgrave Macmillan, London, 2006.

200. Ibid.

201. Ibid., p.74.

202. Dick Bryan and Michael Rafferty, "Fundamental Value: a Category in Transformation, *Economy and Society*, Volume 42, Issue 1, 2013, http://www.assoeconomiepolitique.org/political-economy-outlook-for-capital-

ism/wp-content/uploads/2012/06/D-Bryan-Fundamental-value.pdf

203. Dick Bryan and Michael Rafferty, *Capitalism with Derivatives: A Political Economy of Financial Derivatives*, Capital and Class, Palgrave Macmillan, London, 2006, p.35.

204. Bryan and Rafferty recognize that derivatives do not *actually* determine fundamental values ("for there are no truths here"): what matters, they argue, is that markets perceive them to do so and act on that basis, despite the contradictions and inevitable crises that such misplaced practice creates.

205. Ibid, p.75 and p.64.

206. Quoted in PriceWaterhouseCoopers, *Treading a New Trading Path: The Impact of Regulatory Change on Commodity Trading and Risk Management in the Power and Utilities Sector*, PWC Power & Utilities Roundtable Discussion Paper, 2013, p.4, http://www.pwc.com/en_GX/gx/utilities/publications/assets/pwc-treading-a-new-trading-path.pdf

207. Ibid.

208. Ibid.

209. G. A. Petch, "A Mid-Victorian Employer on Factory Management", *Bulletin of the Business Historical Society*, Vol. 25, No. 4, December 1951.

210. A. H Birch, *Small Town Politics, A Study of Political Life in Glossop*, Oxford University Press, 1959.

211. G. A. Petch, "A Mid-Victorian Employer on Factory Management", *Bulletin of the Business Historical Society*, Vol. 25, No. 4 December 1951.

212. David Harvie, "Review of *Capitalism with Derivatives: A Political Economy of Financial Derivatives, Capital and Class*", *Economic Issues*, Vol. 13, Part 2, 2008, http://www2.le.ac.uk/departments/management/documents/people/david-harvie/HARVIE-David-ReviewDickBryan.pdf

213. Peter Monaghan, "William Arkwright" *in* Frank N. Magill (ed), *Dictionary of World Biography, Volume IV: The Seventeenth and Eighteenth Centuries*, Salem Press, 1999.

214. Trefor Thomas, "Lancashire and the Cotton Mill in Late Victorian Fiction", *Manchester Region History Review* XIII, 1999 http://salamancacorpus.usal.es/SC/LD_N_1800-1950_LAN_Prose_Mather_Bio_files/Trefor_thomas.pdf

215. Geoffrey Russell Searle, *Morality and the Market in Victorian Britain*, Clarendon Press, Oxford, 1999, p.271.

216. David McNally, "Beyond the False Infinity of Capital", *in* Robert Albritton and John Simoulidis, (eds.), *New Dialectics and Political Economy*, Palgrave Macmillan, London, p.8: "Capital's infinitizing movement (its unending drive to produce surplus value and expand) thus requires that it embed itself in the finite forms of means of production and concrete labour. Capital thus confronts an inherent conundrum: its drive to infinity, to make itself an absolute abstraction, requires its immersion in the sphere of finitude; value can expand only by a journey through the sphere of usevalues. Capital's 'solution' to this conundrum is to strive endlessly to negate all the limits imposed upon it by actual use-values, to try to overcome its own fixity (finite determination) by reducing the time spent in the sphere of production (where it is 'locked' into the use-value forms of raw materials, plant and equipment, and concrete labour). If it were possible – which it is not – capital would take leave entirely of the sphere of production of use-values in order to assume the 'pure' form of money breeding money; it would utterly annihilate space in favour of time."

217. E.J. Cleary, *The Building Society Movement*, Elek Books, London, 1965.

218. Tim Hunt, "Workers of the world cooperate!", *Red Pepper*, June 2010, http://www.redpepper.org.uk/Workers-of-the-world-co-operate/

219. For discussion, *see*, for example: Andrew Liman, *The Failure of Capitalist Production: Underlying Causes of the Great Recession*, Pluto Press, 2012; Costas Lapavitsas, *Profiting without Producing: How Finance Exploits Us All*, Verso 2013; Harry Shutt, *Beyond the Profits System: Possibilities for a Post-Capitalist Era*, Zed, 2010; Michael Hudson, *The Bubble and Beyond: Fictitious Capital, Debt Deflation and Global Crisis*, Islet, 2012.

220. Costas Lapavitsas, *Profiting without Producing: How Finance Exploits Us All*, Verso, London, 2013.

221. Ibid, p.38.

222. Tony Norfield, "Derivatives and Capitalist Markets: The Speculative Heart of Capital", *Historical Materialism*, Vol. 20, No.1, 2012, pp.103–132.

223. Ibid.

224. "Written evidence submitted by the Centre for Research on Socio-Cultural Change (CRESC)", *Banking Standards*, Written Evidence, Parliamentary Commission on Banking Standards: A joint committee of the House of Commons and the House of Lords, 2012, http://www.publications.parliament.uk/pa/jt201213/jtselect/jtpcbs/writev/banking/banking.pdf; Aditya Chakrabortty, "The Wrecking of Barclays is Organized Looting by Those at the Very Top", *The Guardian*, 9 July 2012, http://www.theguardian.com/commentisfree/2012/jul/09/wrecking-of-barclays-organised-looting

225. Costas Lapavitsas, *Profiting without Producing: How Finance Exploits Us All*, Verso, London, 2013, p.39.

226. European Federation of Public Service Unions, Re-municipalization of the Germany energy sector, November 2011, http://www.epsu.org/IMG/pdf/Germany_Energy_Sector_Remunicipalization.pdf

227. Sukhdev Johal and Karel Williams, "The Enfield Experiment", CRESC, 1 July 2013, http://www.cresc.ac.uk/sites/default/files/EnfieldExperiment_0.pdf

228. R. D. Lipschutz, R. D and S. T. Romano, *The Cupboard is Full: Public Finance for Public Services in the Global South*, Municipal Services Project, Occasional Paper 16, May 2012, http://www.municipalservicesproject.org/publication/cupboard-full-public-finance-public-services-global-south-0

229. For discussions, *see* David Harvey, *The Enigma of Capital and the Crisis of Capitalism*, Profile, London, 2010; David Harvey, *The New Imperialism*, Oxford University Press, Oxford, 2005.

230. Hugh March and Thomas Purcell, "The Muddy Waters of Financialization and New Accumulation Strategies in the Global Water Industry: The Case of AGBAR", *Geoforum* 53, 2014, pp.11–20.

231. Hariom Manchiraju, Spencer Pierce and Sri S. Sridharan, "The Economic Substance of Derivatives Structures", Indian School of Business and Kellogg School of Management, September 2012, http://events.isb.edu/AccountingResearchConference/File/Derivatives-paper.pdf; David Lindorff, "Researchers Find 62 per cent of Derivatives Used by Oil" and "Derivatives: Not Just for Hedging", *Treasury & Risk*, 25 September 2012, http://www.treasuryandrisk.com/2012/09/25/derivatives-not-just-for-hedging

232. Eirek Tandberg Olsen, Gaute Egeland Sanda, and Stein-Erik Fleten, "Selective Hedging in Hydro-Based Electricity Companies", 2010, http://mpra.ub.uni-muenchen.de/47820/1/MPRA_paper_47820.pdf

233. Costas Lapavitsas, *Profiting without Producing: How Finance Exploits us All*, Verso, London, 2013, p.36.

234. Zoltan Pozsar, Tobias Adrian, Adam Ashcraft, Hayley Boesky, *Shadow Banking, Federal Reserve Bank of New York Staff Reports*, Staff Report No. 458, July 2010, Revised February 2012, http://www.newyorkfed.org/research/staff_reports/sr458.pdf; *see also* ICMA European Repo Council, *Shadow Banking and Repo*, March 2012, http://www.icmagroup.org/assets/documents/Maket-Practice/Regulatory-Policy/Repo-Markets/Shadow%20banking%20and%20repo%2020%20March%202012.pdf

235. In the late 1990s, such fees constituted more than 40 per cent the total non-interest revenues of US banks. *See* Dick Bryan and Michael Rafferty, *Capitalism with Derivatives: A Political Economy of Financial Derivatives, Capital and Class*, Palgrave Macmillan, London, 2006, p.49.

236. For other examples, *see* Christopher A. Schindler, "Energy derivatives: the likely impact of derivatives regulation on North Dakota utilities", Presentation to the North Dakota Law Review Energy Law Symposium, 9 April 2010, *North Dakota Law Review*, Vol. 85, 2010, http://web.law.und.edu/lawreview/issues/web_assets/pdf/85/85-4/85NDLR907.pdf

237. C. Culp and J. P. Forrester, "Structured Financing Techniques in Oil & Gas Project Finance: Future Flow Securitizations, Prepaids, Volumetric Production Payments, and Project Finance Collateralized Debt Obligations", draft of chapter *in* Kramer, A.S. and Fusaro, P. C., (eds.), *Energy & Environmental Project Finance Law & Taxation: New Investment Techniques*, Oxford University Press, 2010, available at: http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID1429501_code12316.pdf?abstractid=1429501&mirid=3

238. Bryan J. Noeth and Rajdeep Sengupta, *Is Shadow Banking Really Banking?*, Federal Reserve Bank of St Louis, October 2011, http://www.stlouisfed.org/publications/re/articles/?id=2165

239. Michael Coleman, "An Architecture for Flexible Trading" *in* Peter C. Fusaro and Jeremy Wilcox, *Energy Derivatives: Trading Emerging Markets*, Energy Publishing Enerprises, 2000, p.219.

240 . "Spark Spread Option", *Investment & Finance*, http://www.investment-and-finance.net/derivatives/s/spark-spread-option.html

241. S.J. Denga and S.S. Oren, "Electricity Derivatives and Risk Management", *Energy*, Vol. 31, 2006, http://www.ieor.berkeley.edu/~oren/pubs/Deng%20and%20Oren-86.pdf; Michael Hsu, "Spark Spread Options Are Hot!", *Electricity Journal*, March 1998, http://www.erasmusenergy.com/downloadattachment.php?aId=edfc78def714c3c38c6edaf1dfb17055&articleId=116

242. Anne Ku, "That Exotic Option Called Power, *Risk Management*, December 2002, http://db.riskwaters.com/data/eprm/pdf/december/management.pdf

243. James Meek, "Human Revenue", *London Review of Books*, 34, 2012, quoted in John Allen and Michael Pryke, "Financializing Household Water: Thames Water, MEIF, and 'Ring-Fenced' Politics", *Cambridge Journal of Regions, Economy and Society*, No. 6, 10 May 2013.

244. John R. Hodozoal, "The Securitization Swindle: Bailout for Utilities, Bad Deal for Consumers", *The Electricity Journal*, October 1997.

245. John Allen and Michael Pryke, "Financializing Household Water: Thames Water, MEIF, and 'Ring-Fenced' Politics", *Cambridge Journal of Regions, Economy and Society* Vol. 6, 10 May 2013.

246. Edward LiPuma and Benjamin Lee, *Financial Derivatives and the Culture of Risk,* Duke University Press, 2004, pp.39-41.

247. *See* Group of 20, "High Level Panel on Infrastructure – Recommendations to the G-20", Final Report, 26 October 2011, http://www.g20-g8.com/g8-g20/root/bank_objects/HLP_-_Full_report.pdf; Group of Twenty, "Final Communiqué", G-20 Leaders Statement, 19 June 2012, http://www.g20.org/images/stories/docs/g20/conclu/G20_Leaders_Declaration_2012.pdf.

248. M. Kumar and M. Williams, "India Boosts Infrastructure with Tax-free Bonds", *Reuters*, 9 July 2010, http://in.reuters.com/article/idINIndia-5000832010070.9

249. A. Atiya, "India Outlines Details for Infra Debt Funds", *Infrastructure Investor*, 27 June 2011, http://www.infrastructureinvestor.com/article.aspx?article=61764

250. V. Pattabhiraman and M. Dochow, "Accessing Asia", *Infrastructure Investor: Emerging Markets Handbook* 2012, PEI, 2012, p.38, http://www.infrastructureinvestor.com/resources/Infrastructure/II_EM_June%202012.pdf

251. "Philippine Government offers PPP guarantees", *Infrastructure Investor*, November 2010, http://www.infrastructureinvestor.com/article.aspx?article=57504

252. "Hope Springs Eternal", Week in Review, *Infrastructure Investor*, 28 October 2010.

253. "Regulation 28 Set to Boost SA Hedge Fund Industry", *hedgeweek*, 5 April 2011, http://www.drake-advisors.com/news/regulation-28-set-boost-sa-hedge-fund-industry

254. Hsiang-Ching Tseng, "China LPs Provided Unprecedented Liberties", *Private Equity International*, 18 August 2011, http://www.privateequityinternational.com/article.aspx?article=62688

255. S. Srivastava, "Pension Funds Eye India Infra Firm Fundraising", *Infrastructure Investor*, 3 September 2010, http://www.infrastructureinvestor.com/article.aspx?article=55818

256. Matt Taibbi, “Looting the Pension Funds: All across America, Wall Street is Grabbing Money Meant for Public Workers”, *Rolling Stone*, 10 October 2013, http://www.rollingstone.com/politics/news/looting-the-pension-funds-20130926page=5#ixzz2j2Y-C9uIQ

257. Dean Baker, “The Origins and Severity of the Public Pension Crisis, Center for Economic and Policy Research”, Washington, D.C., February 2011, http://www.cepr.net/documents/publications/pensions-2011-02.pdf

258. “Finding the Finance”, *Environmental Finance*, 21 August 2012.

259. Marc Gunther, “Investment in Africa Starts to Pay Off”, *CNN Money*, 18 February 2008, http://money.cnn.com/2008/02/13/magazines/fortune/gunther_africa.fortune/index.htm?postversion=2008021809

260. David Elzinga, Lew Fulton, Steve Heinen and Oscar Wasilik, *Advantage Energy: Emerging Economies, Developing Countries and the Private-Public Sector Interface*, International Energy Agency, 2011, p.30 and p.37, http://www.iea.org/publications/freepublications/publication/name,4006,en.html

261. “US, China, “South Africa lead rebound in Q2 2013 clean energy investments”, *Bloomberg New Energy Finance*, 11 July 2013, http://about.bnef.com/press-releases/us-china-south-africa-lead-rebound-in-clean-energy-investment/

262. “The Billion-Dollar Question”, *Environmental Finance*, 5 October 2012.

263. David Nelson and Brendan Pierpont, *The Challenge of Institutional Investment in Renewable Energy*, Climate Policy Initiative, 2013, http://climatepolicyinitiative.org/wp-content/uploads/2013/03/The-Challenge-of-Institutional-Investment-in-Renewable-Energy.pdf

264. Philippine de T’Serclaes, “Money Matters: Mitigating risk to spark private investments in energy efficiency”, International Energy Agency, 2010, http://www.iea.org/publications/freepublications/publication/money_matters.pdf

265. Ibid.

266. Navigant Research, “Remote Microgrids: Commodity Extraction, Physical Island, Village Electrification, and Remote Military Microgrids: Global Market Analysis and Forecasts”, 2013, http://www.navigantresearch.com/research/remote-microgrids

267. David Nelson and Brendan Pierpont, “The Challenge of Institutional Investment in Renewable Energy”, Climate Policy Initiative, 2013, http://climatepolicyinitiative.org/wp-content/uploads/2013/03/The-Challenge-of-Institutional-Investment-in-Renewable-Energy.pdf

268. Soma Dutta, “Energy as a key variable in eradicating extreme poverty and hunger: A gender and energy perspective on empirical evidence on MDG #1”, Discussion Paper, DFID/ENERGIA project on Gender as a Key Variable in Energy Interventions, December 2005, http://r4d.dfid.gov.uk/PDF/Outputs/Energy/R8346_mdg_goal1.pdf

269. George Caffentzis, *In Letters of Blood and Fire: Work, Machines and the Crisis of Capitalism*, PM Press, Oakland, 2013, p.78.

270. Peter Dicken, *Global Shift: Mapping the Changing Contours of the World Economy,* Guilford Press, New York, 2007.

    From the 1980s onward, Foreign Direct Investment (FDI) flows grew faster than cross-border trade; from 1990 to 2009, they quintupled, reaching a historic peak before plummeting in the financial crisis. The growth of international trade has outpaced world economic growth since the 1960s. The percentage of US corporate profits produced in foreign facilities grew from about five per cent in 1950 to 20 per cent in 1990. Between the early 1980s and the late 1990s, according to George Caffentzis, the number of potential workers “directly exploitable by US capital . . . increased by approximately three billion” (George Caffentzis, “From Capitalist Crisis to Proletarian Slavery”, *in* Midnight Notes, *Auroras of the Zapatistas: Local and Global Struggles of the Fourth World War*, Autonomedia, Jamaica Plain, MA, 2001, pp.231-32).

271. M. D. Levine and N. T. Aden, “Global Carbon Emissions in the Coming Decades: The Case of China”, *Annual Review of Environment and Resources* 33, 2008, pp.19-38; Y. Yunfeng and Y. Laike, “China’s Foreign Trade and Climate Change: A Case Study of CO2 Emissions”, *Energy Policy* 38, 2010, pp.350-56.

    A decade ago, US manufacturing was the largest in the world, four times greater than China’s; today the US has slipped into second place. In 1970, the US produced 29 per cent of the world’s commodities; by 2009 the figure stood at 18 per cent (Greyhill Advisors, *Manufacturing Output By Country*, 2011, http://greyhill.com/manufacturing-by-country).

272. D. Guan, G. P. Peters, C. L. Weber and K. Hubacek , “Journey to World Top Emitter: An Analysis of the Driving Forces of China’s Recent CO2 Emissions Surge”, *Geophysical Research Letters*, 36, 2009; C. Le Quéré, M. R. Raupach, J. G. Canadell et al., “Trends in the Sources and Sinks of Carbon Dioxide”, *Nature Geoscience* 2, 2009, pp.831-36; J. Pan, J. Phillips, and Y. Chen, “China’s Balance of Emissions Embodied in Trade: Approaches to Measurement and Allocating International Responsibility”, *Oxford Review of Economic Policy,* 24, 2008, pp.354-376; C. L. Weber, G. P. Peters, D. Guan and K. Hubacek, “The Contribution of Chinese Exports to Climate Change”, *Energy Policy* 36, 2008, pp.3572-77.

273. M. Xu, R. Li, J. C. Crittenden and Y. Chen, “CO2 Emissions Embodied in China’s Exports from 2002 to 2008: A Structural Decomposition Analysis” *Energy Policy,* 39, 2011, pp.7381-88.

274. Not surprisingly, the boom in Foreign Direct Investment (FDI) in China since the 1990s has been accompanied by a great expansion of energy provision: nearly 2.9 times more energy was supplied in 2010 than in 1990. Corresponding figures for India are 2.3, for South Africa 1.6, for Mexico 1.5, and for the US 1.2.

275. *See*, for example, http://www.sourcewatch.org/index.php/Opposition_to_coal_in_China http://sierraclub.typepad.com/compass/2013/08/coal-mortality-and-protests-in-china.html http://thinkprogress.org/climate/2011/12/21/393761/video-30000-chinese-occupy-coal-plants

276. S. J. Davis and K. Caldeira, “Consumption-Based Accounting of CO2 Emissions”, *Proceedings of the National Academy of Sciences* 107, 2010, pp.5687-92;

G. P. Peters, J. C. Minx, C. L. Weber and O. Edenhofer, "Growth in Emission Transfers via International Trade from 1990 to 2008", *Proceedings of the National Academy of Sciences* 108, 2011, pp.8903-08.

277. M. Cole, "Trade, the Pollution Haven Hypothesis and the Environmental Kuznets Curve: Examining the Linkages", *Ecological Economics* 48, 2004, pp.71-81; C. Dick, "Do Environmental Characteristics Influence Foreign Direct Investment Growth? A Cross-national Study", *International Journal of Comparative Sociology* 51, 2010, pp.192-209; K. P. Gallagher, "Economic Globalization and the Environment", *Annual Review of Environment and Resources* 34, 2009, pp.279-304.

278. M. Xu, E. Williams and B. Allenby, B. "Assessing Environmental Impacts Embodied in Manufacturing and Labor Input for the China-US Trade", *Environmental Science & Technology* 44, 2010, pp.567-73.

279. Andreas Malm, "China as Chimney of the World: The Fossil Capital Hypothesis", *Organization and Environment* 25, 2012, pp.146-77, p.151.

280. *See* Charles Fishman, *The Wal-Mart Effect*, Penguin, London, 2007; Gregg Spotts, *Wal-Mart: The High Cost of Low Price*, Disinformation, New York; John Lanchester, "The Price of Pickles", *London Review of Books*, Vol. 28, No. 12, 2006, pp.3-6.

281. Sociologist Andreas Malm trenchantly criticizes the tendency of much academic and scientific literature to assume that "our daily consumption and production decisions drive global emissions" (E. G. Hertwich and G. P. Peters, "Carbon Footprint of Nations: A Global, Trade-Linked Analysis", *Environmental Science and Technology*, 43, 2009, pp.6414-20, p.6419): "In what sense these decisions are in fact 'ours' is not clear. The danger here is that continued targeting of the Western consumer as an abstract generality – or, worse yet, Western workers – guarantees the failure of climate politics, even if moving beyond production-based accounting, as the real culprit would be left untouched and unnamed" (Andreas Malm, "China as Chimney of the World: The Fossil Capital Hypothesis", *Organization and Environment* 25, 2012, pp.146-77, p.167).

282. Ibid., p.153.

283. J. Ceglowski and C. Golub, "Just How Low are China's Labor Costs?" *The World Economy*, 30, 2007, pp.597-617; H.-F. Hung, "America's Head Servant?" *New Left Review,* November/December 2009, pp.5-25; E. Lett and J. Banister, "China's Manufacturing Employment and Compensation Costs: 2002-06", *Monthly Labor Review*, April 2009, 30-38; D. T. Yang, V. W. Chen and R. Monarch, "Rising Wages: Has China Lost its Global Labor Advantage?", *Pacific Economic Review* 15, 2010, pp.482-504; J. Banister and G. Cook, "China's Employment and Compensation Costs in Manufacturing through 2008", *Monthly Labor Review,* March 2011, pp.39-52.

284. C. Cattaneo, M. Manera and E. Scarpa, "Industrial Coal Demand in China: A Provincial Analysis", *Resource and Energy Economics* 33, 2011, pp.12-35.

285. *See* http://www.iea.org/stats/prodresult.asp?PRODUCT=Electricity/Heat.

286. S. Dan, "Energy Restructuring in China: Retrospects and Prospects", *China and the World Economy* 16, 2011, pp.82-93.

287. *See*, e.g., C. Bellak and M. Leibrecht, "Improving infrastructure or lowering taxes to attract foreign direct investment?", *in* K. P. Sauvant, L. Sachs, K. Davies and R. Zandvliet (eds.), *FDI perspectives: Issues in International Investment,* Vale Columbia Center on Sustainable International Investment, New York, 2011, http://www.vcc.columbia.edu/files/vale/content/PerspectivesEbook.pdf.

288. *See* http://www.nytimes.com/2012/01/22/business/apple-america-and-a-squeezed-middle-class.html?pagewanted=all&_r=1&]

289. Netherlands Environmental Assessment Agency, *Trends in Global CO2 Emissions: 2013 Report*, The Hague, 2013.

290. *See*http://www.youtube.com/watch?v=KMkJu8S8ztEhttp://www.eastasiaforum.org/2011/12/17/the-wtos-made-in-the-world-initiative/http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htmhttp://www.oecd.org/innovation/made-in-the-world.htmhttp://www.huffingtonpost.com/michele-nashhoff/changing-to-wtos-made-in-_b_1536758.htmlhttp://www.wnd.com/2012/06/are-you-ready-for-made-in-the-world/http://www.nytimes.com/2012/01/29/opinion/sunday/friedman-made-in-the-world.html?_r=0

291. G. P. Peters, J. C. Minx, C. L. Weber and O. Edenhofer, "Growth in Emission Transfers via International Trade from 1990 to 2008", *Proceedings of the National Academy of Sciences* 108, 2011, pp.8903-08.

292. http://www.iea.org/etp/tracking/esci/index.html. *See also* http://data.worldbank.org/indicator/EN.ATM.CO2E.EG.ZS.

293. J. G. Canadell, C. Le Quéré, M. R. Raupach et al., "Contributions to Accelerating Atmospheric CO2 Growth from Economic Activity, Carbon Intensity, and Efficiency of Natural Sinks", *Proceedings of the National Academy of Sciences* 104, 2007, pp.18866-70.

294. International Energy Agency, *World Energy Outlook 2012*, http://www.worldenergyoutlook.org.

295. Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.165. Today, there exist an estimated one billion personal computers and three billion cellphones.

296. *The Economist*, "Special Report on Outsourcing and Offshoring", 19 January 2013, p.7. In 2010, wildcat strikes hit foreign-owned factories. Disrupting supply chains, the strikes succeeded in forcing pay rises, and authorities responded by raising minimum wages across the industrial districts. One estimate put the average pay rise for migrant laborers in 2010 at 40 per cent. The trend persisted, with strikes once again affecting affiliates of Apple, IBM, Nike, Adidas and others.

297. Demetri Sevastopulo, "Delta Blues", *Financial Times*, 23 January 2014, p.11.

298. The Corner House, *Energy Alternatives: Surveying the Territory*, Sturminster Newton, Dorset, 2013, http://www.thecornerhouse.org.uk. *See also* Richard York, "The Paradox at the Heart of Modernity: The Carbon Efficiency of the Global Economy", *International Journal of Sociology* 40, pp.6-22.

299. The result will tend to cancel out any superior production efficiencies On the one hand are countries

with efficient technologies for power generation and transport; with high tax revenues devoted to infrastructure. On the other are nations constantly being pushed to scramble to expand infrastructure to keep pace with development and hence to resort to suboptimal equipment and the cheapest available fuel.

300. Jean-Claude Debeir, Jean Paul Deléage and Daniel Hémery, *In the Servitude of Power: Energy and Civilization through the Ages,* Zed, London, 1991, p.236.

301. Andreas Malm, "China as Chimney of the World: The Fossil Capital Hypothesis", *Organization and Environment* 25, 2012, pp.146-77, p.167.

302. Quoted in Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude*, Greystone, Vancouver, 2012, p.150.

303. Amy Wendling, *Karl Marx on Technology and Alienation,* Palgrave Macmillan, London, 2011, pp.115-117, 173.

304. Robert Albritton, "Capitalism in the Future Perfect Tense", *in* Robert Albritton, Makoto Itoh and Richard Westra (eds.), *Phases of Capitalist Development: Booms, Crises and Globalizations*, Palgrave, London, 2002, pp.125-140, p.137.

305. From one per cent in the 1990s, annual growth of global CO2 emissions accelerated to an average 3.4 per cent between 2000 and 2008 (J. G. Canadell, C. Le Quéré, M. R. Raupach et al., "Contributions to Accelerating Atmospheric CO2 Growth from Economic Activity, Carbon Intensity, and Efficiency of Natural Sinks", *Proceedings of the National Academy of Sciences* 104, 2007, pp.18866-70; C. Le Quéré, M. R. Raupach, J. G. Canadell et al., "Trends in the Sources and Sinks of Carbon Dioxide", *Nature Geoscience* 2, 2009, pp.831-36).

    The financial crisis caused only a brief recess. Having fallen by 1.3 per cent in 2009, global emissions rebounded in 2010 by 5.9 per cent to an all-time record level (P. Friedlingstein, R. A. Houghton, G. Marland et al., "Update on CO2 Emissions", *Nature Geoscience 3*, 2010, pp.811-12; G. P. Peters, G. Marland, C. Le Quéré et al., "Rapid Growth in CO2 Emissions after the 2008-2009 Global Financial Crisis", *Nature Climate Change* 2, 2012, pp.2-4).

    In 2012, however, rates of annual growth in global carbon dioxide levels returned almost to 1990s levels (a bit over 1 per cent) after the galloping rates of 2000-2008 (around 3 per cent). The Netherlands Environmental Assessment Agency attributes this slackening of the rate of increase to investments in energy efficiency, shale gas and renewable energy sources, and looks forward to an era of indefinitely-dwindling carbon intensity in which CO2 emissions are steadily "decoupled" from global capital accumulation. *See* Fred Pearce, "A New Course for Global Emissions?", *New Scientist* Vol. 220, No. 2942, pp.6-7.

    Yet if the easing of the rate of increase is due to shale gas – whose development actually increases the total long-term pool of underground carbon slated for extraction – and efficiency – which historically has merely accelerated overall fossil use through the so-called Jevons Effect (*see* The Corner House, *Energy Alternatives: Surveying the Territory,* The Corner House, Sturminster Newton, 2013, pp.27-45, http://www.thecornerhouse.org.uk) – then the euphoria of The Netherlands body is likely to be misplaced.

306. Giondomenico Majone, "Rise of the Regulatory State in Europe", *in* Wolfgang Muller (ed.), *The State in Western Europe: Retreat or Redefinition?*, Cass, London, 1994.

307. John Bell and Thomas T. Sekine, "The Disintegration of Capitalism: A Phase of Ex-Capitalist Transition", *in* Robert Albritton, Makoto Itoh and Richard Westra (eds.), *Phases of Capitalist Development: Booms, Crises and Globalizations*, Palgrave, London, 2002, pp.37-55, p.52.

308. Paul Mattick, *Business as Usual: The Economic Crisis and the Failure of Capitalism*, Reaktion, London, 2011.

309. Whatever improvements in carbon intensity are made, overall volumes of emissions continue to rise. *See* The Corner House, *Energy Alternatives: Surveying the Territory*, The Corner House, Sturminster Newton, Dorset, 2013, http://www.thecornerhouse.org.uk.

310. Alex Morales and Marc Roca, "EBRD Scraps Most Financing for Coal Power Plants", Bloomberg, 10 December 2013, http://www.bloomberg.com/news/2013-12-10/ebrd-scraps-most-financing-for-coal-power-plants.html; Shaun Tandon, "US Ends Most Financing of Overseas Coal Projects", Agence France Presse, 29 October 2013.

311. Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production", *Review of Radical Political Economics,* Vol. 6, No. 2, 1974, pp.60–112, p.112.

312. David Harvey, *A Companion to Marx's Capital*, Verso, London, 2010, p.138.