**‘King Coal is Dead! Long Live the King!’**
**The Paradoxes of Coal’s Resurgence in the Emergence of Global Low-Carbon Societies.**

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*The Paradoxes of Resurgent Coal and Low-Carbon Transition*

Energy is surging up policy agendas worldwide, responding to multiple, overlapping crises of energy supply and demand, political turmoil at sources of key energy resources and climate change generated by fossil fuel emissions. Policy discourse of ‘transition’ to ‘low-carbon’ (usually renewable) energy technologies is now ubiquitous. Yet one shocking trend challenges this picture: coal, the most polluting, high-carbon (i.e. simply ‘carbon’!) fuel, is not merely stubbornly maintaining absolute or relative levels, but undergoing a ‘phenomenal’ (Smil, 2010:144), ‘historically incredible’ resurgence (*Economist*, 2012).

Nor is this trend decelerating. ‘[B]y 2006’ it was ‘the world’s fastest growing fuel’ (Montgomery, 2010:95). The Fukushima nuclear disaster has prompted several high energy-consuming countries, including Japan and Germany, to expand coal-powered electricity (Washington Post, 2011; Smil, 2010:94), while prices for American coal exports are falling with the shale gas boom (*Economist*, 2013). The biggest source of coal’s growth, however, lies in developing countries, especially China and India. The cheapest, most abundant and highly calorific of fuels, coal’s attractions for energizing development are clear. Coal is forecast to surge back into the global no.1 spot, overtaking oil in 2020s-2030s; and at absolute levels dwarfing its commanding heights a century ago.

Coal, however, never went away. It has been a major material underbelly to the ‘dematerialized’ hi-tech knowledge economy; and will inevitably persist as attempts at low-carbon transition unfold, given its structural importance to current patterns of economic growth and the apparently inherent (if unfortunate) slowness of energy transitions (Smil, 2010; Montgomery, 2010), which current trends show no sign of falsifying. Fossil fuels will

still contribute 64% - i.e. the *overwhelming majority* – of energy *growth* for the crucial (regarding emissions mitigation) period of 2010-30 (vs. 83% 1990-2010).

Given slow energy transitions, which must *themselves* be energised, therefore, coal confronts us with a paradox: the central role of fossil fuels in powering transition to low-carbon societies. A paradox, moreover, all the more excruciating when a trilemma is acknowledged: the largest source of medium-term emissions growth will be large developing economies; low-carbon innovation and deployment will not happen there *without* further development, which means increased coal consumption; and there is no historical precedent of economic development without commensurately increased emissions (Edenhofer, 2010; Ockwell, 2008). Yet low-carbon transition remains urgent. The result is emergence of a powerful new discourse of 'clean coal', focused on carbon capture and storage (or sequestration) (CCS).

The International Energy Agency (IEA) calculates that CCS could contribute over 15% of global GHG emission reductions needed for the mid-century target of 450 ppm of $CO_2$ (Tollefson, 2011). This would need 3200 CCS projects sequestering 150 $GtCO_2$. In fact, CCS is dragging along, with virtually no progress since 2007 and not a single full-size coal-fired power plant with CCS in operation. Yet – another paradox – 'clean coal' remains very much alive as a policy dream, with a powerful and growing group of supporters bolstered by an aggressive global PR campaign (e.g. www.coalcandothat.com).

These multiple paradoxes of 'clean coal' need elaboration and explanation. In doing so, however, we address three key points. First (section 2), we introduce the theoretical argument that 'energy' – conceived as social, cultural and political socio-technical systems – must be explored as a key explanatory factor in accounts of social change and, in particular, of the *power* that executes and is itself formed by such change. Only from this perspective can we examine the nature and implications of coal's contemporary resurgence.

This leads to the second argument, that there are crucial inter-relations between the dominant power regime and energy systems of particular socio-historical formations. This opens up new possibilities for social critique of energy systems; past, present and emerging. This argument is illustrated (sections 3 and 4) regarding multiple complex connections between the power regime of nineteenth century liberalism and a coal-dominated energy system that underpinned the birth of industrial capitalism.

Finally, a more speculative application of the first two points is developed, as substantive illustration of this perspective's contribution to understanding, and critique, of contemporary developments in energy systems. Here, 'clean coal' is shown to provide a window into political and socioeconomic trends that will underpin low-carbon transition efforts in coming decades; and, thus, into the form of 'low-carbon' societies likely to emerge from them.

*1) Energizing Society, Powering Society*

Confronting the urgency of low-carbon transition while 'taking society seriously' (Urry, 2011) raises the question: 'how is society energized?' Social forms, as living systems, depend upon flows of energy maintaining their systemic viability far from thermodynamic equilibrium (Smil, 2010). 'Energy', therefore, is never just another resource or commodity, another 'sector' of the economy, but central to a social system's very metabolic survival. Moreover, since only the simplest forms of energy may be harnessed without infrastructures (Smil, 2010:12), energy resources are always mediated through socio-technical systems that give them a particular social meaning and systemic role. Finally, a thermodynamic perspective must acknowledge a system's *entropic*, not merely energic, costs (Biel, 2012).

From a social perspective, attention to entropic flows raises crucial questions of where and how the massive entropic costs of industrial capitalist and consumerist society (Smart, [this issue]) are dispersed and (possibly) accepted; a question of particular importance since global capitalism appears to be testing the entropic limits of the biosphere (Biel, 2012). Yet these processes of inclusion and exclusion, ordering and dumping of disorder, immediately alert us to often-neglected connections between flows of energy and power. From this perspective, the key questions become: *How* is energy produced and used, and how does it *construct* and *drive* social systems? How does it *power* society? And how does it 'power power': the political coalitions, dominant and resistant; ways of life and social practices from which these emerge; and forms of political regime they themselves in turn condition? This demands analysis of complex systemic positive (and negative) feedback loops: between production and consumption of negentropy; development of negentropy sources and sinks, hence entire socio-technical systems and their 'energy sector'; 'common-sense' trajectories of development; and materialized discourses and relations of control thereof (Mitchell, 2009).

Crucially, power is here conceived not as brute coercion that must be tamed and legitimized by social consensus. Instead, power is productive not merely oppressive, ubiquitous and dispersed not possessed, and hence normatively ambiguous not a matter of censure. The focus is thus on the 'how' of power, as in Gramsci (1971) and/or the later works of Foucault (e.g. Foucault, 2004, 2009, 2010; see Jessop & Sum, 2006). Moreover, these power *relations* are dynamically constructed and performed in concrete material-discursive practices and 'power technologies'. Going beyond Foucault, however, power may thus take the form of socio-historical *regimes*, the systems emergent from constellations of heterogeneous power techniques that in turn condition (the emergence of) practices, institutions and subjectivities (Tyfield, 2012a). This allows analysis of how, within a regime, the 'going on' of practices is willingly, actively and, possibly, hegemonically achieved, even by those at whose cost the system runs.

This theoretical perspective offers important lessons in the abstract regarding the politics and sociology of climate change (Giddens, 2010; Urry, 2011). It forces acknowledgement of the irreducible role of power in the dynamics of transition, in terms of construction and emergence of new social forms; forms, moreover, that will themselves be characterised by new power relations/constellations. Moreover, this perspective affords important substantive insights regarding the *form and distribution* of this new power, the *specific political regimes of low-carbon society*, as we explore in section 6.

### *2) Liberalism as Dominant Power Regime*

The key inter-relations between energy and power regimes are specific and concrete, not merely abstract. Coal provides an excellent historical illustration of this regarding the most important (i.e. dominant) political regime of a growing global capitalism over recent centuries, namely liberalism. By 'liberalism' we here connote a power regime not a political philosophy nor (liberal, representative) democracy. Rather, liberalism consists of 'living dangerously' (Foucault, 2009:384) and minimal government, i.e. government by and through (construction of) freedom(s), and hence an elite politics capable of achieving popular acceptance and active participation, even of the disenfranchised and burdened (Gramsci, 1971). The key question regarding liberalism and power, therefore, is 'how is this possible'?

A crucial insight here, opening up possibilities of social critique, is to stress liberalism's two faces, their mutual dependence and co-production, as well as their tensions. On the one hand,

productively, liberalism must be interrogated in terms of the regimes of productive growth, as new (socio-technical) techniques and practices emerge that (unpredictably, *a posteriori*) reinforce each other in positive feedback loops; i.e. precisely the process of transition and emergence. Liberalism *works*, therefore, through (construction of) new knowledgeable *freedoms*, but always and only for (the benefit of) some (Losurdo, 2011). Key elements of this process are thus the new enabling truths, knowledges and associated institutions/groups, both of techno-scientific expertise and of legitimation.

Yet, negatively, liberalism is also and always establishing the 'security' conditions of intelligibility of the former. This thus establishes the 'paradoxes of liberalism', an essential split in liberal society (Foucault, 2010:61-70) that elicits an intrinsic fear and aggression but is *itself* produced by liberal power technologies. Governing through (new) freedoms, liberal power regimes are fundamentally dependent upon legitimation through both institutions and concrete decisions that accord with what is, in parallel, socially defined as 'rational'. In particular, the key question for liberalism is the known, knowable 'real' limits of state power; a question that manifests in the acute importance of knowledge of real and/or 'naturally' self-regulating processes that supposedly generate spontaneous social order, particularly the market. Insofar as such 'knowledge' may be performatively self-legitimating, 'to govern well' *really is* 'to govern less' (Gordon, 2000: xxviii). The necessary flipside of such concern for natural limits, however, is the *limits* of nature, definition of that which is 'unnatural', which compromises 'natural self-regulation' and so is an existential threat; and so should be delegitimized, feared and destroyed. In governing by producing freedoms, therefore, liberalism also necessarily involves ('rational') delineation of and active construction of system-existential security threats. Liberalism is thus marked by an inherent social binarism, a 'racial' struggle to 'defend society' against its mortal, eternal and unnatural foes (Foucault, 2004). And as such it is characterised by a schizophrenia, haunted by an irreconcilable shadow side that it itself produces.

Just as the productive aspect of liberal power regimes may be explored regarding positive feedback loops of socio-technical change and sedimentation of power coalitions, so too can such analysis be pursued for the negative face. Yet here focus is on new truths/knowledges of *de*legitimation; new delegitimated (possibly 'racial') subjectivities; and new practices, groups and institutional forms associated with these. As an emergent system, however, these two faces are not to be investigated separately but precisely in their co-construction.

To these two faces, however, we must add a third issue, namely the crucial contradistinction – being an historical, interpretive process – of the emerging dominant regime to that which preceded it. This socio-historically situated contrast provides critical conditions of intelligibility for the success of the former; what may be called the 'disciplinary lessons of history'. Most importantly, this takes the form of the newly knowledgeable definition (and hence 'responsible', 'rational' acknowledgement) of the 'security' threats 'of the age', which thereby accords various virtues to the new liberal regime as 'true' as well as 'progressive', 'contemporary' etc…

But what is the connection here to coal? First, historically we explore some mutual connections between energy and power regime – coal and classical nineteenth century British liberalism respectively – focusing especially on their parallel rise to dominance; i.e. the 'transition' to a coal-fired liberal regime. Then, secondly, we deploy the framework in a more speculative social critique of contemporary energy-power relations regarding coal's resurgence and an emerging low-carbon society based on 'clean coal' and CCS innovation.

### *3) King Coal and Classical Liberalism*

Tracing the 'how' of power regarding coal (production, distribution, consumption) in the early/mid-nineteenth century, the age of emerging dominance of industrial society, illuminates parallel processes of transition to dominance of the power regime of the time, namely the hegemonic 'classical liberalism' of British *laissez faire* and early industrialism. A full account of these connections would be a substantial undertaking in its own right, resonating with broader attempts at re-reading history from an Anthropocene perspective that takes the non-human agency of geology and energy flows into account (e.g. Dalby, 2007; Clarke & Yusoff, [this issue]). This analysis thus focuses on the two sides of liberalism: a productive regime; and its shadow of 'security' and exclusion.

First, regarding the socio-technical system, coal was central to the emergence of industrial society, generating self-reinforcing dynamics of political and economic profit along with new freedoms. The social meaning of coal arose from its material inseparability from iron and steam (Freese, 2003:66) in positive feedback loops of increasing demand and supply and falling costs, via: steam-powered water pumps for coalmines; coke (substituting wood-

sourced charcoal with partially-combusted coal) and mechanical blast furnaces; railways and steamships; and, later, mechanized factories and engineering tool-shops.

These positive dynamics of coal extended far beyond the 'coal' economy. In its abundance in the newly empowered nation-states and its uniquely intense energetic content, coal was the entropic presupposition of a 'new "energetic metabolism", based on cities and large-scale manufacturing' (Mitchell, 2009:402; Nye, 1998:99); new both in its spatial arrangement of discrete, concentrated sites of production and (industrial) consumption and in the huge increase in *systemic* entropic demands. Substituting wood by coal facilitated massive release for agriculture of land preserved for trees, which conditioned an agricultural revolution and massive increase in food production (Mitchell, 2009; Pomeranz, 2000). Together with colonialism and global trade, themselves built upon new coal-steam-iron technologies of mobility and conquest, these afforded production and transport of sufficient food to meet demand in these growing industrial urban centres.

The system transition, however, was also a power transition, constructing the archetypal power technologies of classical liberalism. In business, new limited liability companies responded to the 'economic advantage in large-scale operation' and increasingly evident potential for 'a large market' epitomized by coal-based industries (Nye, 1998:108). Indeed, the 'huge capital requirements of such [coal-based] enterprises made the corporate form of organization virtually mandatory' (p.104). Moreover, the 'ability to unleash the power of coal through steam launched an intoxicating [and self-propagating] era of optimism and excitement' (Freese, 2003:73). No growing body of 'truth' better captured this sense or was materially corroborated more than classical liberalism's central dogma, namely Adam Smith's 'invisible hand' of the naturally self-regulating market (e.g. Polanyi, 1945/1991). Coal-based socio-technical change thus *demonstrated* the *natural limits* of government, the heart of liberalism.

Yet, coal also constructed, depended upon, excluded and delegitimated another shadow world; its 'security' flipside that evoked an 'unacknowledged schizophrenia in national self' (Johnson, 2010:267). As a leading contemporaneous liberal commentator, de Tocqueville, noted on visiting Manchester, 'here humanity attains its most complete development and its most brutish' (quoted in Freese, 2003:72). Coal was 'a type of traumatic knowledge'

(Johnson, 2010:271), but 'traumatic' precisely because of the inseparable connection between *both* civilisation *and* depravity, culture *and* debasement, freedom *and* exploitation.

Moreover, the practices of coal's production and consumption also instantiated precisely the 'racial' binarism(s) intrinsic to liberalism's elite power technologies. In the household, class and gender distinctions were pronounced by coal-based heating; tending and stoking fires was hard, dirty, time-consuming women's work, while a gentleman would benefit from year-round comfort, Emerson's 'portable climate' making 'Canada as warm as Calcutta' (Freese, 2003:10). Similarly, soot and smoke dirtied and degraded clothes, providing graphic sumptuary differences between classes able to afford large wardrobes and/or regularly wash clothes (Freese, 2003). In providing starkly different levels of comfort, environmental hazard (e.g. diseases from coal pollution and deprivation of sunlight, including childhood rickets) and access to the alimentary benefits of improving diets, class was even evident in physical size and gait, turning different classes into seemingly distinct biological races.

Yet narratives of racial distinctiveness and struggle were also powered by coal in other crucial ways, these legitimating the 'natural order' of exploitation on which the liberal-industrial regime depended. Most obvious is the powering of colonialism and, crucially, slavery (Losurdo, 2011), including in cotton production for the booming textile mills central to early coal-based industrialization. Similarly, at the heart of the coal free-market economy, Freese (2003:45) notes how 'miners and their families, commonly referred to as a separate race of humans, were increasingly ostracized by society.'

These racial categorizations then legitimated the assumption, *and wilful acceptance*, by some of the population of the new risks of the age. Consider the extraordinary dangers of mining: explosions; sudden asphyxiation; roof collapse; drowning, especially as mines were dug ever-deeper; falling down shafts or collisions with coal-trucks; as well as the 'normality' of backbreaking, cramped work. British miners surveyed in 1851 and 1861, for instance, had mortality rates of nearly 20% by age 20 (as opposed to 2% for 'persons of rank or property'), and nearly three quarters by age 45 (vs. 24%) (Coyle, 2010:207).

To be sure, the assumption of these risks was not without resistance and, indeed, classical liberalism's emergence was a process constituted by resistance as much as by domination. Consider, for instance, the subsequent emergence towards the century's end of a powerful

socialist movement; a development in which the systemic importance of coalminers, in a position of largely unsupervisable control of the key energetic resource, and, thence, their increasing success at unionization, was absolutely crucial (Mitchell 2009, 2011). Yet the very fact that such unified, powerful resistance took nearly a century after classical liberal industrialism's initial take-off to emerge, despite a century of exceptional revolutionary fervour (Hobsbawm, 1962), also shows the importance of coal in construction and maintenance of this 'shadow world'; which was, in turn, inseparable from the initial productivity and emergence of the liberal-coal system.

*4) Neoliberalism and After*

We return now to explore contemporary energy 'transitions'. Yet, in doing so, we must first attend to the contemporary power-energy regime that current developments aim to transcend, namely (oil-based) neoliberalism. The key dimensions of the globally-dominant neoliberal regime have been elaborated elsewhere (e.g. Crouch, 2011; Harvey, 2005; Mirowski & Plehwe, 2009) and recent scholarship has also begun to detail the intricate connections with an oil-dominated energy system (Mitchell, 2011; Urry, 2013). For our purposes, however, of most importance are the 'disciplinary lessons of history' that neoliberalism's current crisis presents as context for ongoing efforts at 'low-carbon transition'.

Neoliberalism is undeniably a form of liberal power regime in the central importance it accords the market in limiting 'rational' state government. Yet, is is also a striking departure from classical liberalism. The characteristic truth and knowledges of neoliberalism concern the epistemic regime of the 'market of ideas' (Mirowski, 2011). This conceives of the market and its virtues *primarily* as an epistemic, and not allocative, phenomenon. The market optimizes, as automatic outcome of spontaneous interaction of (negatively-)free individuals, the social aggregate of all human knowledge, in the form of materialized knowledges that succeed on the market. The trans-personal, automatic epistemic mechanism of the market, it is argued, thus necessarily instantiates better-informed decisions than could possibly be made by any rational planner.

The implications of this market foundationalism (if not 'fundamentalism' *qua* zealotry) are profound. For, absent any rational gainsaying of the market, there are simply *no knowable, real limits* to the market nor to that which may be optimized by subjecting it to market discipline; a market will always reach a better decision regarding government of a

phenomenon than 'rational' policymaking. *Apparent* limits or the emergence of new threats and risks are thus merely new opportunities for Promethean entrepreneurship. Conversely, classical liberalism is essentially concerned to demarcate and then police the 'natural' limits and necessary preconditions of liberal, free-market government. A particular instance of 'market failure' for neoliberalism thus does not represent the legitimate task of a limited state power but rather a task for the state to *construct* conditions, using *unlimited* power if necessary, such that the market *does* 'work'. This radical strain of liberalism is thus also its negation in its crucial (and self-contradictory) dependence upon unfettered expansion of state power in the project of marketizing all aspects of society.

This is evident in a specific model of innovation involving state-sponsored accumulation by dispossession of public and common knowledges through strong global intellectual property rights (Tyfield, 2008). This model also focuses on innovations that: yield the promise of high, short-term returns, especially as financial(izable) assets; yield products that service the market demands of corporate/individual consumers, rather than publics or states; and are compatible with corporate enclosure of bodies of knowledge that promise to maximize global corporate control of crucial sectors, such as food (e.g. genetically-modified crops) or health (e.g. biotechnology/pharmaceuticals).

Conversely, innovation in energy – involving large, public infrastructures, dependent upon broad knowledge-sharing and taking many years to develop – would typically meet few, if any, of these characteristics. Indeed, there has been an almost complete lack of progress in energy innovation since the 1970s (Smil, 2010:121), when investment was booming in response to the OPEC oil shocks and seeming 'limits to growth' (Meadows et al., 1972). This is primarily due to a collapse in energy R&D investment from the 1980s, with neoliberalism's advent to global dominance, for at least two further reasons. First, neoliberalism is systematically disinterested in any ecological-entropic or energy resource limits to market-based economic growth, except insofar as these are opportunities for further entrepreneurial profit. Secondly, following the monetarist 'counter-revolution' (Arrighi, 1994) and the global reassertion of (now neoliberal) American dominance, the processes of financialized creative destruction, the defeat of OPEC and then the USSR's demise all conditioned return of the 'good times' of cheap, seemingly unlimited and dependably secure oil that corroborated neoliberal rejection of limits to growth (Mitchell, 2011; Urry, 2013).

Yet this process has now come to a crashing halt, in the multiple, overlapping crises that a generation of neoliberalism has conditioned. What next, then, for a revitalized post-crisis capitalism and its associated political regime of a re-emergent liberalism?

*5) 'Clean Coal', China and Liberalism 2.0*

Coal will be a, or even *the*, key energy resource as low-carbon transition slowly unfolds. 'Clean coal' thus provides a particularly insightful window on the interdependent near-future emergence of energy and power regimes. From this perspective, the key questions are: how can coal be redefined socially such that it is 'indispensible' *for* low-carbon transition? What must be constructed for this new 'common-sense' to be intelligible? We set out four key dimensions of contemporary challenges of coal, all of which are in emergent evidence, by way of 'notes on an emerging political regime'. This affords a preliminary, speculative formulation of a 'liberalism 2.0' in terms of liberalism's three dimensions, including its fundamental repudiation of the neoliberalism preceding it.

1) China: The first issue for the future of 'clean coal' is the global rise of China, the epochal development of recent decades (e.g. Jacques, 2010). (The rise of) China is inseparable from (the resurgence of) coal and *vice versa*. China today represents 47% of global coal consumption, likely to rise to 53% by 2030, while constituting 80% of growth of world coal demand 1990-2010 and an expected 77% 2010-30 (BP outlook, 2011). China mines 3 billion tonnes a year (three times the amount in the US, global no.2) *and* is the no.1 importer (ahead of Japan since 2011). Between 2000-2008, China more than doubled its coal extraction to 40% of global output – more than that from the 2nd-7th largest combined (Smil, 2010:97). Similarly, domestically, 'no other country is as dependent on coal as China' (Smil, 2010:97), coal representing 70% of electricity generation (95% of all fossil fuels used to produce electricity) and 64% of total primary energy supply (2008).

China is also thus the single most important issue regarding the future of coal and its global environmental impact. By 2020, given its coal consumption, China's GHG emissions are set to overtake the entire OECD excluding the US (Montgomery, 2010:47) and to be double those of the EU (Climate Group, 2009). In short, cleaning Chinese coal is arguably the *sine qua non* regarding prospects of global mitigation of GHG emissions to mid-century (e.g. Friedman, 2009; Watts, 2010). This is all the more so when it is acknowledged that the prospects for the end of the global North's current depression hinges on economic growth in

China and other large industrializing countries (e.g. FT, 2013). And this, in turn, suggests that a geopolitical shift in power regime towards a more Sinocentric world is also increasingly in the global North's self-interest, so that again, energy and power regimes are transitioning in parallel.

China is also central to the future of coal as the most dramatic example of the tensions of environment and development. Coal is central to the continued economic development of many large developing countries for reasons detailed above. To be anti-coal, therefore, can easily be portrayed as to be pro-poverty or even racist, the obsession of the Western environmentalist happy to kick away the ladder to levels of economic prosperity that they themselves enjoy. Moreover, the energy-development-emissions trilemma effectively makes development, and (risk of) concomitant growth in emissions, a prerequisite for global low-carbon transition and dramatic *reduction* in such emissions. The prospects of, and barriers to, China developing a 'clean coal' sector, however, illustrate several other *socio-political* dimensions of the contemporary coal challenge that elaborate the specific socio-cultural meaning of 'clean coal' and the power regime likely to be developed in parallel.

2) A resurgent state and newly defined security threats: The first of these socio-political dimensions is the likely resurgence of industrial policy and importance of the state in business, industry and innovation. This, in turn, is inseparable from forcible reappearance amongst political elites of acceptance of new security threats that the state alone seems able to address. China, its rise and perceptions thereof, will undoubtedly be central to these dynamics.

First, as the pervasive global ontological insecurity from the multiple overlapping crises of the neoliberal era deepens, with increasing protest and unrest, a new dominant dynamic is likely to emerge demanding serious account of, and urgent action regarding, *all* the crises. Furthermore, there is the possible wild card of a global military situation, given positive feedbacks amongst the various crises and an increased systemic sensitivity to political 'shocks'. There is, after all, no shortage of plausible candidates as the spark of a much bigger global conflagration. This would have major implications regarding not just popular political acceptance of the importance of energy security, but also regarding the fortunes of coal. Oil is concentrated in 'difficult' places that are the most likely theatres of any such war, while coal is concentrated in large developed and developing countries. Coal could thus easily be

redefined as ‘secure’ and ‘ethical’ against unreliable, ‘addictive’ and ‘terrorist’ (and ‘neoliberal’) oil.

The acceptance of these new ‘security threats’ thus is also acceptance of a redefinition and expansion of the *legitimate* role of the state in limited liberal government. And while state mobilization for war is the most obvious manifestation of such expanded power, the ‘need for massive investment in infrastructures to extract, harness, process, transport and covert energies’ (Smil, 2010:125) – and for the low-carbon innovation needed to decarbonize energy – is itself a major argument for such expanded state power (and associated forms of enterprise) *given the context of the new ‘normal’ of pervasive security threats* in which energy (security) plays such a central role. At the intersection of triple economic, energy and environmental crises, this would include, for instance, the national importance of incubating emerging clean-tech industries, including clean coal. Insofar as state support is deemed crucial for success of such industries, this also provides the argument for expansion of the state and a revitalized industrial policy across the world, in both ‘developed’ and ‘developing’ countries. China is again central here; the nation-state whose global rise, using a model of massive state-owned enterprises especially in core national interests such as energy and telecoms, is the global exemplar of this new paradigm.

This suggests the first set of ways in which the power regime of ‘clean coal’ will likely mark a definitive break with neoliberalism. First, it provides and is fundamentally built upon a new discourse of security threats and possibilities of market failure, while neoliberalism accepts no such existential challenges or limits. Secondly, this new liberalism also thereby accepts, and is premised upon, an explicit argument for the legitimate, but limited, expansion of state power. Indeed, in both respects, this new liberalism can therefore present neoliberalism as *itself* a constitutive element of the security threats and the inability of the prior regime to address them; while re-empowerment of states may also afford the necessary counterweight to bring financialized, tax-avoiding, global neoliberal elites (Urry, forthcoming) finally to heel.

Such a liberalism, therefore, is also a revised form of ‘classical liberalism’, which was also perfectly compatible with, and indeed dependent upon, growth of the state as the vehicle for ‘defending’ emergent bourgeois society. Yet it is *revised* (‘version 2.0’) given precisely the transformation of the state over the preceding neoliberal period. The expanded state is thus

also qualitatively transformed. China is again an exemplar in this regard, with coal mining itself a key example. For even though this is an industry that certainly remains in the hands of the state, precisely as a security priority, these are no longer simply monolithic hierarchical and centrally-planned enterprises. Rather, the organization of business is increasingly subjected to neoliberal market disciplines and its mines are increasingly concentrated and part-privatized (Wright, 2006), thereby destroying public and/or collective forms of ownership and associated socialist/social democratic connotations of the 'state'. This is also increasingly true regarding the role of the state in innovation, including in energy. Against the worn-out neoliberal refrain of the state's ineptitude in 'picking winners', the Chinese state is slowly developing just the capacities of the 'flexible state' (Mazzucato, 2011) now being counselled by Western innovation scholars as the route out of economic stagnation. In short, economically China is increasingly the exemplar of a renewed (classical) liberalism precisely *because* of its strong, but neoliberalized, state-owned enterprises.

3) An emergent socio-technical regime of electrified, low-carbon transition: A key dimension of liberalism is a productive socio-technical energy system and its positive feedback loops, which generate its dynamism and social power vis-à-vis contending regimes. 'Clean coal' forms a central node in an emerging system of 'low-carbon' electrified technologies and practices, of both use *and innovation*, that also make central use of the web 2.0-enabled social media of the (increasingly smart-phone hosted) internet. 'Clean coal' is thus part of a clean coal-*electricity* socio-technical system, no longer steam power and heating, and so associated with clean, 'smart', modern development not dirty, backward, industrial labour.

China, again, is likely to be a central player in these developments in coming decades. This is not only because of the enormous and growing social importance of Chinese social media (Yang, 2009), with the world's largest on-line population and a whole generation of young, on-line Chinese entrepreneurs determined to get their piece of a vision of growing Chinese prosperity. But in major 'sectors' of the economy, the improving capacity for and specific technological focus of Chinese low-carbon innovation offers crucial self-propagating dynamics. For instance, regarding urban mobility, China stands alone in its commitment, at all levels of government and from major national corporations, to development of electric vehicles (Tyfield, 2012b). These initiatives will continue to increase demand for clean electricity, while reducing consumption (and imports) of GHG-emitting oil. But meeting

these demands for increased electricity will simply mean other, and possibly increased, pollution; unless, that is, China's 'black', coal-fired electricity generation is transformed into 'green' clean coal.

China is also crucial to the emergence of such a new socio-technical system given the key question of the source of (consumer) *demand* for low-carbon innovations (Bhidé, 2009) and the 'opportunities for growth' needed to attract massive levels of investment (including from Western private finance). A crucial element of any emergent low-carbon regime, therefore, will be the (discourse of the) rise of the materially aspirational 'billions' that constitute the emergent 'middle class' of the large, fast-developing countries, China in particular (Cheng, 2010; *Cf* Guo, 2008). Coal will have a central role to play in constructing their material prosperity and the growing consumerism for all *other* commodities, including the electrified platforms of 2.0-connectivity. But the growth of this class is also likely to strengthen domestic political demands for pollution control and hence clean coal; an issue already attaining new levels of political importance given the emergence of 2.0-enabled protest, particularly by the urban, young and 'middle class' (Xiao, 2011).

The totemic centrality of the Chinese middle class to this political regime also provides a further way in which it breaks with neoliberalism. Instead of being a political project increasingly rejected by Chinese society for benefitting only a tiny elite, notably the cadre-capitalist class (So, 2003) with its rampant corruption and speculative financial and real-estate profits, the incorporation of a broader, if still highly circumscribed, Chinese middle class would represent a re-legitimization of the political regime. Prosperity itself will also, thereby, be re-legitimized as the hard-earned fruits of tough, competitive work, most probably in 'productive' sectors of the economy; including, of course, knowledge-based work and (green) innovation.

In terms of emergence of clean coal, and CCS in particular, here too *socio*-technical conditions offer key insights into a political regime capable of supporting its systemic emergence. Key elements of the global discourse of CCS are already apparent, in terms of being a 'triple win' for environment, economy and energy that is resulting in 'phenomenal' levels of business interest in the UK (Black, 2012). Hence, the UK's CCS competition is portrayed as a 'route out of the [economic] crisis', with the CCS industry's potential value to the UK estimated at £6.6bn per annum by 2020 (Morgan 2012).

To make a meaningful impact on climate change mitigation, deployment of CCS must be fast and massive (see above). Yet, CCS innovation is currently stalled around the world. Only 74 projects have been actually announced (*Cf* 1500 the IEA estimates to be needed to be operational by 2035) and the 'trend is in the wrong direction' (Watts, 2011). For instance, the US flagship CCS project, Futuregen, was abandoned in 2008, then restarted by the Obama administration but with little and uncertain progress since then. Similarly, in the UK, whose government is amongst the most supportive of CCS, its competition for CCS projects and research was relaunched in 2012 after an earlier attempt from 2009 finally came to naught in 2011 with the cancellation of the only remaining project at Longannet.

None of this paralysis, however, appears to be diminishing political support for CCS as a crucial element of low-carbon transition. Hence the most plausible reading of CCS is that initiatives are likely to continue but they develop the capacity for 'clean coal' much slower in reality than suggested by the rhetoric which will be needed to support them. The problems of CCS thus also provide a window into the conditions under which it begins to succeed. And while the US, Canada and EU are currently leading in terms of number and progress of CCS ventures (Worldwatch, 2012), it is again in China that the most significant developments have been in recent years.

Key to these has been a seeming change of heart around 2009/10 in the Chinese government's attitude to CCS (Friedman, 2009; Watts, 2011). As CCS emerged onto policy agendas in the 2000s, China was clearly reluctant to take any lead in developing the technology, given perceptions of its expense as a penalty on development and of the responsibility for mitigation resting primarily with the global North. In recent years, however, the Chinese government's interest in CCS seems to have changed. A report by the Worldwatch Institute (Carbon Capture Journal, 2011) argues that 'China could become a world CCS leader (and technology exporter) within the next two or three decades', a conclusion supported by the IEA (China Daily, 2011). The Worldwatch report notes the 'significant and encouraging progress' even as 'Chinese CCS development still lags behind the world leaders'. Evidence of progress in the flagship Greengen project corroborates these conclusions (Tollefson and van Noorden, 2012).

If CCS does become a viable prospect in China, both commercially and technologically, and an industry that offers genuine prospects of global Chinese dominance, however, the global fortunes of CCS innovation will be utterly changed. Such is the importance of coal to China that a China doing CCS will make it a globally viable technology, thereby stimulating the commercial competition and investment that are currently lacking. This, of course, would be another crucial positive feedback loop in the emergent clean coal-electricity system. Implications of such innovation for the emergent political regime, however, are mediated by the new knowledges and truths of such a system.

4) Knowledges: CCS innovation provides an excellent example of the constellation of uncertainties besetting low-carbon transition more generally (Tyfield, 2013). Markusson et al. (2012), for instance, list 7 key uncertainties that are currently major obstacles to CCS take-off. As well as various techno-economic uncertainties (e.g. regarding the challenges of long-term 'safe storage'), however, there are also key uncertainties associated with 'economic and financial viability', 'policy, political and regulatory uncertainty' and 'public acceptance'. These latter uncertainties, especially, may be discussed from a power perspective in terms of discourses that will legitimize both such innovation and the government policies to support it.

Even to acknowledge these latter issues is, again, to make a distinct break with neoliberalism. From a neoliberal perspective, there should be no question regarding the economic viability of an innovation since it is up to the market to decide if it should succeed and this is precisely what *will* happen. Similarly, public acceptance is not a matter of political deliberation but is and should be simply a matter of sufficient consumer demand (or not) for the product. Furthermore, the solutions implied by such questions – namely, the need for 'additional policies [i.e. state intervention] to support CCS' (Markusson et al., 2012:909) – also display significant shifts away from a free market radicalism.

But, the types of knowledge and institutions of knowledge production to tackle these uncertainties of CCS innovation also illuminate what this new political regime *is*, as well as what it categorically is not. While increased state involvement to some extent seems necessary, even this is not enough given the exceptional challenges of coordination for a socially engineered, highly time-pressured and global transition (Tyfield, 2013). These challenges are fundamentally ones of the knowledge of policy-makers and their all-too-apparent limits in the face of the complex, non-linear, multi-factorial challenges they are

hoping to tackle. As a result, management of these problems demands new types of knowledge (both technical and political/legitimatory) and new institutions of knowledge production. In both respects, the emergence of web 2.0-enabled networks is absolutely central.

On the one hand, regarding technical knowledges, the challenges of the multiple uncertainties of CCS described exemplify a broader shift in policy thinking – away from market fundamentalism – about issues of energy, innovation and their respective political economies. First, these uncertainties highlight precisely the complexity and non-linearity of the problems – of climate change, energy systems and coordinating their multi-agent transition – from which political interest in CCS springs. Secondly, a further irreducible complicating factor is that CCS projects must be developed in specific geographical places, against the presumptive globalized universality of neoliberal 'common-sense', which can treat locations as largely interchangeable when deciding where to offshore a semiconductor 'fab' factory. Thirdly, CCS itself is only being pursued *at all* to the extent that it promises to solve (or at least mitigate) an existential security threat, not purely as a self-evident opportunity for profit. It is thus an example of the new age of 'responsible' innovation needed to tackle these challenges. But the very *model* of this innovation is also 'responsible' in that it takes seriously precisely the complexity of problem and solution; for instance, in acknowledging the importance of, and informational gains in, 2.0-enabled professional knowledge-sharing networks and 'public engagement'. This process is, of course, precisely to manage the new crises and risks through an *expansion of freedoms*, the acme of (classical) liberal government; but here as a 'liberalism 2.0' in which knowledge must flow and be constructed in such web-2.0 networks, rather than via the nineteenth century's individual, private and elitist expertise.

On the other hand, regarding knowledges of legitimation, complexity of the problems and their solution can also be harnessed through web-2.0 social media, opening up the resulting knowledge production to a much broader (set of) public(s). This is a process that is already well underway not only in the global North but also increasingly in authoritarian and one-party state China (Xiao, 2011); a form of 'consultative Leninism' (Tsang, 2011) that both contains but also employs web-based popular expressions of outrage to manage risks and complexity.

Moreover, this new empowerment of Chinese society precisely benefits the class that is the symbol of the emergent socio-technical regime. For it is the emergent 'middle class' – overwhelmingly in large and developed cities, young, educated and engaged in 'knowledge work' – who are online and participate in such political protest, especially regarding technical risks. Yet, as the Chinese internet best exemplifies, this construction of new freedoms is not only the construction of new avenues for the government of societal threats, but also entirely compatible with a commensurate *increase* in powers of state surveillance and coercion. In short, therefore, just as China exemplifies a classical economic liberalism precisely because of the strength of its state-owned enterprises, so too China in fact increasingly exemplifies a classical *political* liberalism (regardless of whether or not there is the oft-anticipated 'Chinese Spring') precisely *because* it is an *anti*-democratic, elite-bourgeois regime. The construction of clean coal and Chinese global leadership in CCS exemplifies, and could construct, precisely this form of government.

5) <u>The new 'spectres'</u>

For (classical) liberalism, the negative and positive faces were inter-dependent. Similarly, what is the new shadow world, the systemically necessary exclusions that afford a critique of the emerging 'low-carbon' society of a Sinocentric world? We briefly outline two examples of the newly excluded subjectivities thus constructed.

Key here is the dynamic of liberalism's inherent social binarism, played out in redefinition of the new *intra*-national losers as a racial other who are to be ignored, contained and repressed. For instance, on the one hand, the growth of clean, dependable, but relatively more expensive, clean coal-electricity conditions profitable investment in and growth of hi-tech knowledge jobs, especially for the BRICs middle class. This, in turn, affords their (possibly green) consumerism and creates new win-win profitable opportunities for further 'middle class' jobs. Moreover, these are also opportunities for Western businesses, creating a new *global* dynamic of economic growth and growing prosperity. Intrinsically excluded, however, are the expanded industrial workforce in these same countries that is an irreducible concomitant of increased middle class consumerism; workers, moreover, now employed in hugely powerful quasi-state enterprises that are evermore highly automated and mechanized thereby auguring deskilled and insecure employment, and who face comparative energy poverty given unsubsidized national energy markets subject to the carbon taxes/prices that make CCS commercially viable. This resonates with current trends of fiscal austerity,

reduction of welfare states and a lack of solidarity with benefit claimants in the erstwhile 'core' (e.g. NCSR, 2012), suggesting an economic convergence between China and the global North, up *and down* respectively.[1]

Secondly, the new materialized discourses of 'complexity' and 'responsible innovation' provide a new common-sense epistemology underpinning liberalism 2.0's new-found legitimacy. This facilitates and legitimates the self-propagating interactions amongst growing 2.0 knowledge networks of CCS engineers/innovators, improvement of Chinese innovation capacity, and development of complex knowledges and their 2.0 'open' institutions; thereby embedding the robustness (and so, power) of this socio-technical system. But, conversely, these materialized discourses also deepen the possibility of exclusion and delegitimation of numerous positions and voices from political debates regarding low-carbon transition. For instance, the environmental activist, outside the relevant CCS networks and opposed to coal *per se* and its (overwhelmingly *un*sequestered) costs, may be written off with increasing ease as someone (whether naively or malevolently) unaware of the complexities of low-carbon transition and the crucial role of coal in this process, *and* of the latest facts on the 'impressive' level of progress in CCS 'now being made'.

This liberal political regime is thus explicitly *not* concerned with *democratic* governance by the whole citizenry. Rather, given the nature of the 'global' security threats (thus defined) and the advantages of massive state-supported corporations, this also presages a *political*, and not just economic, convergence between the West and China towards various systems, all of which *de facto* rule by and on behalf of a growing (globally-)connected knowledge 'middle class'.

As such, with the new systemic losers both newly encumbered *and* delegitimized, this demands greater policing, thereby *constructing* the truth of the 'enemy in our midst' that perpetually haunts the new system and constitutes the new common-sense of security threats, especially given the vivid memories of (the, as yet in 2013, far-from-over) systemic crisis. A 'clean coal' low-carbon transition thus suggests a future in which dramatic intra-societal inequalities and violence continue from the end of the neoliberal era; societies reminiscent of

[1] Luce (2012) notes the accelerating 'hollowing out of the middle class' in the US. 'US median household is 4.8 per cent poorer now than at the start of the recovery in 2009. Median incomes have now fallen to the pre-internet level of 1993.'

Dickensian (and liberal) London, with these stark social divisions legitimated as the 'necessary' concomitants and costs of low-carbon progress.

## *6) Conclusion*

Energizing society has recently emerged as a key concern for the social sciences. Such analysis, however, must pay due attention to the interaction of energy/entropy, the construction and maintenance of socio-technical (energy) systems *and* parallel construction of power technologies and political regimes. This paper has provided an initial illustration of such a perspective, tracing multiple connections between coal and liberalism and all that the latter entails: both in the past and, more speculatively, in the medium-term future. In particular, we have highlighted the *essential* social binarism, inequalities and anti-democratic pressures in both instances, suggesting a 'clean coal'-based low-carbon future may well be significantly less 'progressive' than as presented in many high-profile policy visions.

The socio-technical system of 'clean coal' exemplifies and constructs this new power regime. It *energizes* the complex emergence of this new socio-technical system, since the negentropy afforded by (innovation in) clean coal substantially drives the rest of the emergent system. But it also *powers* this process, the construction of new freedoms and coercions, hence new powers, and circuitously itself. In this way, we can appraise clean coal as the multiple paradoxes it is, namely as:

1) 'Green' *and* the most polluting of fossil fuels, massively accelerating GHG emissions as CCS roll-out slowly catches up;
2) 'Clean' and light, especially as mediated by electrification and identified with new, hi-tech knowledge industries *and* heavy, dirty, discredited and invisible industrial labour;
3) An 'essential' part of global low-carbon transition *and* hugely deepening structural dependency on fossil fuels vs. decentralized renewable energy networks;
4) A condition for equitable economic development of non-'Northern' countries and 'innovation catch-up' *and* for intensified and expanded economic exploitation of the 'Southern' working class;
5) A 'responsible' innovation trajectory, as one element in a 'portfolio' of measures to tackle complex global environmental challenges *and* a reckless experiment, at unprecedented scale, with accelerating emissions and anthropogenic climate change;

6) Energizing and empowering a new, more populous and seemingly progressive class – of 2.0-networked, BRICs-inclusive, green knowledge-workers – *and* conditioning a global *de*-democratization, including in the liberal democracies of the global North, towards a bourgeois-elite, liberal regime.

These characteristics are thus both the reprise of 19th century liberalism and its profound transformation, as if reflecting a political regime on the 'way up' and the 'way down', tragedy and farce respectively. To be sure, as in nineteenth century Britain, this will also present new openings and platforms for resistance; resistance, moreover, that will play a constitutive role, in the first instance, in emergence of this liberal low-carbon society. As with classical liberalism, however, we may also expect that formation of unified and powerfully situated sites of resistance will *follow* the system's initial construction, and so can only be imagined even further into the speculative future. The outlines of a movement responding to the critique sketched here, thus, must be the focus of future research.

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