

**Putting the Power in ‘Socio-Technical Regimes’ – E-Mobility Transition in China as
Political Process**

Paper for Special Issue of Mobilities, ‘Mobilities and Foucault’

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Word count (total): 10182

Word count (article): 8696

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Abstract

A mobility low-carbon transition is a key issue both socially and for mobilities research. The multi-level perspective (MLP) is justifiably a leading approach in such research, with important connections to high-profile socio-technical systemic analyses within the mobilities paradigm. The paper explores the key contributions that a Foucauldian-inspired cultural political economy (CPE) offers, going beyond central problems with the MLP, specifically regarding: a productive concept of power that affords analysis of the qualitatively novel and dynamic process of transition; and the incorporation of the exogenous ‘landscape’ into the analysis. This move thus resonates with growing calls for attention to power dynamics in mobilities research and a ‘structural’ turn. In making this case, we deploy the key case study of contemporary efforts towards mobility transition in China. This not only sets out more starkly the importance of MLP’s gaps but also provides an empirical case to illustrate, albeit in the form of informed speculation, possible routes to low-carbon urban mobility transition *and* the inseparability from broader qualitative power transitions at multiple scales, including the global.

Keywords: China, Automobility, System Transition, Electric Vehicles, Foucault, Liberalism

Introduction

Perhaps the greatest challenge for contemporary mobilities research is how, and if, a socio-technical transition to ‘sustainable transport’ (Banister 2008; Geels, Kemp et al. 2013a) is possible. Transportation, which accounts for approximately 25% of global greenhouse gas emissions (GHGs), is key to efforts to mitigate ‘climate change’ and at the centre of this is the socio-technical system of ‘automobility’ (Urry 2004). In this respect, perhaps the most significant single development is the transformation of mobility within contemporary China. Now central to the world economy, in twenty years Chinese society has gone from being predominantly based upon slow means of travel – walking, carts and cycling – to fast modes, especially car and truck. Although its GHG emissions remain small on a per person basis (e.g 0.75 MtC/capita vs. 5.5MtC/capita in the US in 2005 (Winebrake et al. 2008, 218)), it is already the world’s largest emitter (Climate Group 2008), and emissions are growing.

Cars in China have increased from 9.2 million (2004) to 40.3 million (2010), the total number of vehicles from 27.4 million to 90.9 million (NBS 2005, 2011). Growth is expected to continue at 7/8% p.a. in the medium term (Sperling and Gordon 2009, 209). Forecasts vary but range from 60m cars by 2020 and 300m by 2050 (Feng et al. 2004) to 100m as early as 2015 (Chen et al. 2004, quoted in Winebrake et al. 2008, 217). The size of its population and the increasing income of Chinese households have already made China the world’s largest car market. Yet car intensity in China remains relatively low, especially compared with the US. This suggests further dramatic growth, but also enormous problems. American car intensity would seem impossible within China, involving some 970m cars, 50% more than the entire worldwide car fleet in 2003 (Girardet 2004), and the consumption of 102% of current world oil output (calculation using IEA 2011 and Winebrake et al. 2008, 216).

The ‘greening’ of China’s urban mobility, therefore, is an issue of urgent and global significance. But it is also a hugely difficult, complex and multi-layered challenge. Indeed, automobility more generally is arguably the ‘hardest case’ (Geels, Kemp et al. 2013b: xiii; Tyfield 2013) of low-carbon transition. It is thus not entirely surprising that evidence of a significant ‘shift in China is singularly lacking, and this despite significant government and corporate support, especially for electric vehicles. As one, albeit key, example of contemporary efforts to low-carbon transition, the nature of these problems and, thence, the source of their intransigence can be significantly illuminated using an analytical framework focusing on ‘socio-technical systems’, of which the (justifiably) most high-profile is the ‘multi-level perspective’ (MLP) (Geels 2002; Elzen, Geels and Green 2004; Geels and Schot 2007; Van Bree, Verbong and Kramer 2010).

The MLP is part of a broader tradition of innovation studies that has emerged in recent decades devoted to the explanation and/or management of socio-technical transitions (Smith, Voß and Grin 2010), including recently on mobilities (Geels, Kemp et al. 2013a). A ‘heuristic’ for thinking through socio-technical transitions rather than a full-blown theory, the MLP is characterised by a ‘multi-level’ analysis. This centres on a ‘socio-technical regime’ dynamically constituted by a diverse set of social, regulatory, economic and technical factors that have aligned into a dominant system. From below, this regime is challenged by emerging ‘niches’, most of which stay as niches or fail altogether, but some of which may grow to introduce a radical discontinuity in the regime, a ‘system transition’. From above, meanwhile, all this socio-technical action is set within a broader ‘landscape’ of diverse political, economic, social and environmental settings that may be treated as exogenous for the purposes of the MLP analysis (Geels and Kemp 2013, 57-58).

Using this perspective, such analysis has constructed numerous historical accounts of previous system transitions (e.g. Geels 2005) that insightfully weave together the diverse elements involved, representing considerable advances on mainstream (policy) accounts that continue to focus on new technologies to the exclusion of both the irreducible social factors and the systemic nature of stabilized socio-technical settlements and their transition.

However, it is increasingly apparent that the MLP struggles to deliver on the promise that is the primary source of its appeal, not least to policy-makers and policy-connected scholars; i.e. to spot, if not seed and support, the urgent *prospective* low-carbon systems transitions needed today. These problems – and two issues specifically – are particularly striking when we consider the key case of China.

First, alongside the systemic and heterogeneous socio-technical nature of automobility (Urry 2004), the intense interconnection between automobility and the broader character of the global political economy and systems of (geo)political hegemony are starkly exposed when we turn to China. In the mid/early 20th century, the emergence of the system of automobility was inseparable from that of American hegemony and vice versa (Paterson 2007), as they emerged together from the turmoil of the collapse of the nineteenth century British hegemony. Today, we are in a moment of similar epoch-making turmoil. This raises a key question for mobility transitions today of ‘where will be the next Detroit’?¹ - a question that resonates with broader calls for a ‘structural’ or ‘power’ turn in mobilities research (e.g. Salter 2013; Bærenholdt 2013; Sheller 2013). For MLP analysis, such considerations are defined as ‘landscape’ and hence exogenous variables that may usually be treated as stable or, to the extent they are unstable, are to be introduced into the analysis as ‘windows of opportunity’ for socio-technical regime change.

¹ I thank Mat Paterson for this succinct formulation.

What MLP does not – and arguably cannot – accommodate, however, is the actual political reality of automobility (policy) in China; namely that the present is a singular opportunity for *China* to be (home to) the ‘next Detroit’ and where this is explicitly conceived, by government, business and arguably a widely nationalist citizenry, as a crucial part of a broader project of restoring the Middle Kingdom to its rightful place at the centre of the geopolitical order. From the perspective of a Chinese mobility transition, therefore, it is not just apparent but fundamental that everything – the ‘world’ – is in play, as it were. By excluding such considerations from analysis of mobility transition, therefore, the MLP leaves out a key aspect of its dynamics and prospects.

Secondly, and relatedly, contemporary China presents a case of such a rapidly and profoundly changing society, both intra-nationally and inter-nationally, that it is hard, even if one attempts it, to formulate a ‘stable’ landscape that may be unproblematically treated as exogenous. This is all the more so given the crucial role that systems of mobility play in the shaping and constitution of modern societies (Bærenholdt 2013). We are thus quickly confronted with the need for a perspective that can insightfully explore the parallel formation of qualitatively novel automobility system(s) and broader social institutions and common senses. This, again, is something that the MLP’s strict demarcation into given ‘levels’ of analysis and their characterisation as of given quality renders all but impossible.

This paper engages with these weaknesses by offering a development of the socio-technical systems literature that furnishes a more insightful and productive analysis. This hinges on an engagement with the later works of Foucault, namely his *Collège de France* lectures, only recently published in English (Foucault 2004, 2009, 2010). Or more specifically, with a cultural political economy (CPE) perspective that itself draws upon and is inspired by this work. We thus explore two key ways in which an engagement with Foucault’s analysis of

power and governmentality/liberalism contributes to, and fills gaps in, MLP analysis of sociotechnical systems transition, regarding study of emergent systems and analysis of ‘landscape’ issues respectively. This is done both in abstract theoretical argument and then more briefly with the empirical illustration of ongoing efforts to ‘green’ automobility in China.

Automobility and Foucault

Our first step in offering an alternative perspective is to turn to Foucault. In particular, we focus on his later work as a key conceptual resource, rather than as key texts for detailed exegesis. Foucault is drawn upon here neither as the ‘answer’ to outstanding theoretical problems nor as the sole component of an improved theoretical framework. Rather, following others, his work is incorporated within a broader framework of cultural political economy (Jessop and Sum 2006; Paterson 2007; Tyfield 2012) that also draws inspiration from neo-Gramscian (international) political economy and ‘Regulation Approach’ economic sociology, studying the diverse and concrete socio-spatial fixes that regularize the contested processes of capital accumulation at any given time-space such that it may continue relatively uncontested (see also papers by Paterson and Manderscheid in this Special Issue).

For present purposes, two elements of Foucault’s work are drawn upon that develop a socio-technical systems perspective, addressing the conceptual gaps described above: his concept of power; and his more concrete analysis of governmentality and liberalism as a specific form of political regime. Regarding the former, Foucault develops a ‘positive’ conception of power, as against the more familiar and purely negative, juridico-discursive conception that sees power as something that may be ‘held’, hence is concentrated in the hands of powerful and is thus equivalent to brute force, the capacity to force another to do something against their will.

Power is also thus conventionally understood as normatively bad, except to the extent it is rendered legitimate through popular consent.

Conversely, for Foucault, power is not a thing but a relation, not possessed and concentrated but constitutive and (asymmetrically) dispersed, not presumptively bad but normatively ambiguous, not just oppressive and destructive but also productive and ontologically necessary for the construction of all human creations, and not illegitimate until rationally consented to but strategic and ubiquitous. This conception thus offers an analytics of *how* power relations are constituted and in turn constitute the stuff of the world, including the specific power-knowledge technologies (and the assemblages thereof that are constituted through serving specific, contingently emergent systemic functions, or *dispositifs*) that mediate practice and hence enable forms of collective government, (state) institutions, ‘common sense’ and subjectivities.

Such a conception of power is also crucial for the second key conceptual resource drawn here from Foucault. In examining the genealogy of ‘modern’ forms of political ‘common-sense’, Foucault notes the emergence over the last two centuries of specific technologies of rule concerned primarily with ‘rational’ calculation and measurement. These afforded in turn a form of political regime capable of management of ‘risks’ at the level of the ‘population’ through various techniques of ‘rational’ and self- policing, rather than the attempted elimination of specific ‘illegitimate’ forms of behaviour by centralized authorities: a ‘biopolitics’ characterised by governmentality, ‘the conduct of conduct’ (Dean 2010), rather than regimes of discipline. This form of rule is quintessentially liberal.

By ‘liberalism’, we here connote a political regime or system of power technologies, not a political philosophy. Nor, crucially (especially when we turn to China), is liberalism to be identified with democracy. Rather, liberalism is the political regime that seeks to manage

society through ‘conducting (individual) conduct’ in ways that *depend upon* or ‘consume’ (Foucault 2010, 63) individual freedom, thereby harnessing the emerging challenges of modern society to a form of rule that is (in aggregate) self-stabilizing in that it reproduces and constructs the power technologies and power relations that afford ‘system integration’. Clearly, amongst the most important of these emerging challenges is the ‘problem of circulation’ (Foucault 2009 – see also other papers in this Special Issue by Usher, Philo and O’Grady). This connotes the systemic dependence of, first, early modern urban and, then, contemporary global capitalist economies upon unfettered and accelerating personal mobility, but with minimized chaos and ‘danger’ of systemic dysfunction, in the context of governmental programmes of constructing ‘efficient markets’ (Goodwin 2010, 73): a triad of population-governmentality-circulation (Bærenholdt 2013).

From this perspective we may also appreciate the strength of the connection between liberalism and automobility. As Rajan (2006, 115) has perceptively explained, automobility depends upon and instantiates forms of government – both institutional, regarding states and their regulations, and personal, regarding specific subjectivities – that are crucial concrete fora for a more general liberal governmentality, “facilitating the universal exercise of individual liberty”. In analysing the ‘system’ of automobility, therefore, we are directed not just to how practice is conditioned by “highway and gasoline delivery infrastructure, but also more dramatically through the governmentality of traffic rules, parking structures, licensing procedures, and sundry regulatory institutions” (p.115). Driving involves both the exhilaration of speed (congestion allowing) but also “the grave responsibility of having to steer safely and respectfully past others” and “with the vital expectation that the sentiment and capability are mutual” (p.122). These are thus issues of biopolitics, of physical risks and dangers of the population as a whole, but also simultaneously of maximized circulation and of ‘autonomy’, negative liberty and its ‘responsible’ use. Driving – or rather the systemic

dominance of automobility, for drivers and non-drivers alike – is thus a key arena of modern liberal and capitalist life for the “training” of the subjects presupposed by a (not dys-) functional, liberal, capitalist society (Rajan 2006, 122).

Moreover, Foucault’s analysis of liberalism and governmentality also highlights a key aspect, for critical scholarship of low-carbon transitions, of these forms of government and power regime, namely their crucial dependence on techniques of inclusion *and exclusion* and thus their two-sided, and thus normatively problematic, nature. Concretely, these techniques hinge on the fact that the power-technologies that consume and afford ‘freedom’ are also technologies of ‘security’. Here ‘security’ refers to identifying (‘scientifically’) and then managing and minimizing *given* dangers to a population that threaten to undermine the functioning of the system that would ‘naturally’ and spontaneously emerge from the interaction of individual freedoms were it not for these ‘unnatural’ threats. This generates a ‘scientifically deduced’, and so liberal and credible, *a posteriori* distinction between the ‘natural’ and ‘unnatural’/dangerous that, in turn, affords the rational and reasonable imposition of disciplinary and even sovereign (i.e. ‘killing’ or more general extermination) techniques on the latter in order to preserve and maximize the ‘health’ of the population. Technologies of freedom *as* technologies of security thus introduce the (always concrete) distinction between those who are to be allowed to ‘circulate’ as they wish, without the illiberal micro-management of the state – in that such circulation is crucial to the society’s own ‘health’ – and those on whom authoritarian techniques are ‘rationally acceptable’ for precisely the same reasons.

This two-sided nature has several implications. First, liberal (automobility) presupposes an *état de peur* (Lemke 2011,49), a widespread common sense cultural politics that accepts the (scientific) ‘truth’ that certain forms of practice or being threaten the collective system

integrity and thus must, rationally, be feared – an existential ‘security’ threat – and, where possible, eliminated. Yet, conversely, the technologies of freedom and security themselves *generate* this culture of fear (or even terror (Diken and Laustsen 2005)), hence setting up a self-reinforcing dynamic, mediated by knowledge technologies and associated power relations, that not only generates a systemic stability but also, in the first instance, an *expansive* dynamic – essential for a system transition. In other words, the essentially contested dynamic of new freedoms-securities constitutes a powerful dynamic in essentially liberal modern societies for the *emergence* of new socio-technical regimes *as* power transitions.

In this way, new social identities and classifications can emerge and spread in which the ‘included’ increasingly come – in the light of their embodied, affective and practical experiences of both the new benefits/freedoms of the emerging socio-technical system and the dangers and inconveniences of the behaviours and practices it excludes – to identify *themselves* as such (hence generating the crucial new subjectivities) *and in contrast to* the excluded; and where this distinction may be (increasingly widely) understood as rationally, and so (given secular, scientific societies) *morally*, justified – again crucial cultural elements of an emerging system’s momentum and stability. As we shall see, there is *prima facie* evidence of just such a regime-formative, socially-exclusive classificatory process emergent in China associated with disruptive low-carbon mobility innovation. The initial impetus for this dynamic, moreover, is clearly best provided by a generalized sense of crisis, specifically of the dysfunction of crucial socio-technical systems, such as automobility, and of the associated moral economy, as in the contemporary radicalized ‘liberal’ power regime of neoliberalism: in other words, precisely the situation we are now in across the world, including China.

Finally, this suggests that a revitalized, post-transition liberal-automobility system is likely, at the very least, to be normatively ambiguous. On the one hand, the flexibility and ‘rationality’ of this system is what affords its undeniable productivity and the *power* underpinning its emergence and subsequent stability – i.e. the very *potential* for (low-carbon, sustainable) ‘system transition’. But, on the other, this is necessarily at the cost of systematic and ‘rationally irrational’ definitions of social exclusion, their (possibly brutal) enforcement (the more ‘rational’ the exclusions, the more violence is both ‘legitimate’ and rationally organized and so ‘effective’) and thus a schizophrenic zeitgeist of a society that fears the shadow it itself casts or conjures.

As such, this perspective alerts us to the crucial importance, both analytically and politically, of attending in studies of systems transition to their ‘dark side’ (Cf Sheller 2013; Slater 2013, 11). For conceiving transitions as inseparably political and cultural entails not just that we should have a healthy scepticism regarding ‘non-zero sum’ (‘everyone’s a winner’, ‘triple win’, etc...) discourses, but rather that new social distinctions, exclusions and (violent) disciplinary techniques, both state and corporate, are almost *inevitably* going to be part of this process. And acknowledging *this* places a moral responsibility on researchers to analyse, identify, present and, where possible, intervene in (e.g. through participatory research) such emergent inequalities and injustices.

Power and Liberalism in Socio-Technical Systems

Drawing on these Foucauldian conceptions thus opens up a range of methodological, theoretical and substantive perspectives on transformation of automobility. These insights, however, are not merely useful in their own right, but they may also be seen to plug key gaps and tackle crucial problems with the MLP – and indeed within the mobilities paradigm more generally where it assumes an overly ‘systemic’ and under-politicized frame of analysis

(Goodwin 2010, 60; Böhm et al. 2006, 4) hence contributing significantly to broader scholarship on the urgent questions of low-carbon transition. In particular, while the MLP has cogently argued for, and to some extent operationalized, key issues – regarding the inseparably *socio*-technical nature of transition, the importance of a systems perspective and thence attention to complex dynamics of stability and change –, two problems remain especially challenging.

On the one hand, there is the problem of accounting for, and studying in real-time, the emergence and construction of new sociotechnical regimes, including via the articulation or ‘alignment’ (Kemp, Geels and Dudley 2013, 16) of the diverse and heterogeneous social factors and forces (including the ‘windows of opportunity’ presented by landscape-level ruptures), which the MLP rightly emphasises are involved, into seemingly coherent (and increasingly so) ‘systems’. In conceptualizing these simply as ‘factors’, which may be enumerated in various lists (e.g. Geels and Kemp 2013, 63), there is simply no account of how these somehow aggregate into new ‘wholes’. Moreover, the factors themselves must be treated as atoms, qualitatively unchanging at least for the sake of the analysis. This problem manifests, in particular, in the pervasive difficulty of explaining or even conceiving of how present niches may, individually or together, grow in the near future to the point of executing a regime-level discontinuity.

Conversely, a relational, dispersed, productive (‘power to’ (Law 1991)) conception of power directly tackles all of these inter-related problems. Placing productive power at the heart of the analysis furnishes a concept on which to hang the explanation of how a system transition emerges, i.e. as new forms of productive power emerge via new power-technologies and dynamic, strategic power relations, in turn driving the formation of both new socio-technological assemblages *and* the parallel transformations in political coalitions,

governmental institutions, subjectivities and (discourses of) moral economy. As a *power* transition, *how* the ‘pieces come to fit together’ is straightforward to understand, at least in the abstract, in that this process is the outcome of an essentially dynamic process of multiple strategic agencies jostling for position and the connections and coalitions they actively seek in this pursuit; while conversely it is inconceivable how transition can be possible *without* a power transition given that one socio-technical system and another necessarily enable and constrain and are constituted by different strategic agencies and constituencies. Moreover, focusing on the multiplicity of new power technologies and relations in their geographical-historical specificity, and thinking through the emergent broader social impact of their complex and contradictory aggregation, affords a window into the endogenous process of change implicit in a ‘systemic’ evolutionary perspective; particularly important for the analysis of *emerging* socio-technical regimes (in which even institutions may no longer be treated as ‘external variables’). Emergent *qualitative* change, regarding new (socio-technical) orders and ‘common-sense’, is also, therefore, amenable to analysis by focusing on the diverse power-technologies that make such ordering materially and conceptually intelligible.

As such, while MLP scholarship is trying hard to respond to widespread, and long-standing, criticism regarding the absence of ‘power’ and ‘politics’ in its analysis (e.g. Shove and Walker 2007, Kern 2011, Meadowcroft 2009, Smith and Stirling 2007 *Cf* Geels, Kemp et al. 2013a), we can also see that the ways in which this is currently being done miss the point. For the focus has been on explaining the frustrating stability and ‘lock-in’ of existing systems – none more so than automobility – and the (presumptively dastardly) exploitation of ‘power’ by incumbent agents (such as the automotive or oil majors). This is certainly not to deny the crucial importance of such power incumbency, especially in the case of automobility (e.g. Urry 2013). But MLP introduces ‘power’ and ‘politics’ precisely as both a thing concentrated in the hands of the ‘powerful’, in classical juridico-discursive conception, and as

‘just another factor (albeit an important one) that we have left out so far’. MLP continues to find itself in the analytical stalemate of having to explain how the *currently* ‘powerful’ can be unseated (by ‘niches’), when they have all the power; and to lack any concept of the central political aspects of transition and hence any capacity to broach their normative consequences, the motivation for these critiques of MLP in the first place, except insofar as a broad-brushed locked-in ‘high carbon’ system is ‘bad’ and any given ‘low-carbon’ niche is presumptively ‘good’ (Smith, Voß and Grin 2010).

Focusing instead on power relations and technologies also directs attention to concrete phenomena that are neither micro nor macro, neither economic nor cultural nor political, not ‘transport’ nor ‘energy’ sector, but all of these, bridging amongst them. This leads to the second key problem with MLP, namely the analytical gap of the ‘landscape’. As discussed above, it is clear that this *is* a significant gap, and especially when considering, for instance, urban mobility transition in China (vs., say, north-western Europe). For even a cursory familiarity with the issues raised by the former case suggest that numerous ‘landscape’ forces are of central importance in understanding the potential for transition, including the (international) political economy and geopolitics of China’s rise and of the associated international division of labour of innovation and distribution of its super-rents, the neoliberal global regulatory architecture, corporate forms and state-market relations and the multiple crises associated with these and responses to them. Indeed, it is precisely the ‘landscape’ level that is the ultimate policy goal for automobility and innovation policy in China. Moreover, a Foucauldian-inspired analysis of governmentality and liberalism, as political regime, provides theoretical resources with which we can begin to think about the crucial question of the interaction between specific socio-technical systems and broader power regimes. Automobility systems and their socio-technical change thus becomes a singular analytical window on to contemporary issues of epochal significance regarding (global)

political economy – especially given the increasingly central role of automobility in shaping power regimes, given government not just *of* but *through* mobility (Bærenholdt 2013).

Landscape issues and the parallel, co-productive interrelations between such ‘macro’ issues and the ‘meso’ (and ‘micro’) concerns of socio-technical systems change, are thereby incorporated into the very heart of the analysis. The landscape is thus transformed from being a theoretical problem, a gap or blind-spot to be addressed in good time, to the key question that the framework sets out to address, while also simultaneously affording a theoretical analysis that shows just how important the interaction of socio-technical system and political regime is in the dynamics of system transition, viz. automobility-liberalism.

Finally, a CPE-governmentality perspective not only motivates and affords analysis of ‘landscape’ issues but also offers crucial guidance on how and where to explore these issues. For the focus on power relations mediated via knowledge and measurement technologies also alerts us to the possibility that the key technological issue for a mobility or transport transition may well not be in the technologies (i.e. machines) of mobility per se, but rather in *how these interact and coordinate amongst themselves and the power-knowledge technologies they must integrate for this to be possible*. The latter, in particular, mediate, via the dynamics of a politics of new freedoms and new ‘security’ threats and technologies to ‘address’ them, the hugely complex articulation of new mobility socio-technologies amongst themselves, with other ‘domains’ (e.g. agriculture via biofuels, or energy or...), with changes at the ‘landscape’ level of political economy and cultural politics and with the emergent power relations and coalitions that are the actual substance of a socio-technical transition (Tyfield 2013). This, in turn, is a crucial perspective for the case of contemporary ‘greening’ of automobility in that it suggests that much of the action of system transition is ‘off-stage’ vis-à-vis a focus on ‘low-carbon’ innovations, regarding web 2.0 real-time connectivity, ITS (intelligent transport systems) coordination, driverless cars and navigation systems, in-car

entertainment etc... (Cf Sheller 2013). Indeed, this latter list is also where much of the investment of contemporary automobility is actually concentrated.

In short, then, to see early glimmerings of an emerging regime (shift) demands: on the one hand, attention to how new assemblages of heterogeneous power technologies are mediating self-sustaining trajectories of 'low-carbon' automobility innovation; and, on the other, their potential impacts regarding political economy, the reciprocal emergent changes in consumer preferences and cultural politics of automobility, and the emergent evidence of new and changing power blocs, social identities and 'classes', all of which are enabling a self-sustaining dynamic of their strategic growth; and not just in the context of, but also set against and dynamically responding to, incumbent structures, imaginaries and discourses and *their* strategic action of self-preservation (Cohen 2010). In the rest of the paper, we briefly illustrate this perspective regarding China, e-mobility transition and an emerging liberalism 2.0.

E-Mobility Transition in China: Stalled Transitions and Political Openings

Our starting point in such an analysis must be a characterisation of the incumbent socio-technical-cum-power regime. From a systems perspective, despite countless initiatives across the world in multiple 'niches' over the last 15-20 years (Geels 2013) the evidence of any appreciable dent in the automobility system remains sorely lacking (Kemp, Geels and Dudley 2013, 12; Sheller 2013; Cf evidence in the 'rich' world of 'peak car' in Cohen 2012); indeed, conversely, automobility is emerging anew in 'emerging markets' around the world with the potential for massive further growth (Tyfield 2013). And despite the shock of bankruptcies and massive government bail-outs and increasing acceptance by car TNCs in recent years of the need to decarbonize vehicles, there has been no significant transformation in the industry, either as regards its preference of internal combustion engine (ICE) cars (still the focus of the

overwhelming majority of R&D expenditure (Kemp, Geels and Dudley 2013:21)) or as regards the emergence of disruptive new players. Rather, even in crisis and with government support, contemporary neoliberal automobility is simply supporting innovations that attempt the restoration of 'BAU' (business as usual), thereby deepening the crises to which this automobility system has given rise. In particular, even while pursuing innovations to increase the efficiency of the ICE to meet tightening emissions laws and challenges from alternative fuels (Goodwin 2010, 63), the car majors continue to focus on their most lucrative – and gas-guzzling – products for growing international elites (*Cf* Birtchnell and Caletrío 2014 on the negative effects of 'elite mobilities').

The most noticeable exception to this industrial strategy, however, is China. The electric vehicle has been seized upon by central and local governments and (some) companies alike as the break they need to construct globally competitive brands. As a result, China has become the country with the most aggressively supportive industrial policy for electric vehicles, involving significant government subsidies for individual purchases and major programmes of R&D and infrastructure construction (e.g. for charging) (Tyfield and Urry 2012; BCG 2011; Gao, Wang and Wu 2008; World Bank 2011). Some of its smaller, private car companies, notably the battery company BYD, have also accepted global leadership in EVs as their strategic goal. Yet, despite the significant government support, impressive technological capabilities in some key areas (such as BYD's global leadership in batteries) and a competitive landscape that sees little interest from the incumbents, EVs have proved a singular flop in recent years in China. Government targets for EV sales in selected cities have been significantly missed (Wang 2013). And what few purchases have been made have been concentrated in municipal government-controlled taxi fleets, with private sales almost totally absent.

As we have ourselves discussed previously (Tyfield and Urry 2012), this failure is significantly illuminated in MLP terms of socio-technical systems: for instance, regarding the chicken-and-egg socio-organizational challenge of constructing charging infrastructures before drivers will use the cars, but having no incentive to (or no idea where best to) build the infrastructures without the prospect of customers/users. The key issue of the sheer expense of the up-front costs of buying an EV, due to the price of the battery, raises issues of consumer acceptance and choice that are also intrinsically social *and* technological, not one or the other – behaviour change vs. technological fix – as in conventional framing of the problem. Our focus in this paper, however, is the specific insights from incorporating Foucauldian perspectives on power and governmentality-liberalism.

Stability (or ‘lock-in’) of the existing system may be best understood not in the politically-neutral terms of multiple interlocking ‘factors’, nor (just) a conspiracy by powerful incumbents, but rather in terms of the multiple and mutually reinforcing (if complex and contradictory) power-technologies and power relations of neoliberal-automobility as a system. This would thus include all the ‘factors’ of MLP analysis *but conceived as knowledge-power technologies* that specifically enable and constrain certain forms of power relation, e.g.: physical infrastructures of roads and fuel; business and driver lobbies and their technologies of measurement that show how important cars are to the ‘national economy’ including for R&D and global ‘competitiveness’; marketing and advertising industries and discourses that construct competitively consumerist and ‘hyper-individualist’ subjectivities and discourses of freedom.

In each case, however, a Foucauldian-CPE perspective shows how the very sources of robustness of this neoliberal-automobility that underpin the stalling transition are also today the sources of its current crisis and fragility (*Cf* Böhm et al 2006). For instance, in China no

less than elsewhere, roads are increasingly not smooth passages but interminable traffic jams sat in, and producing, unbreathable air; and in an age of austerity and tight credit, as well as stagnant or falling wages, luxury vehicles come to symbolize the gulf between profligate and shameless ‘haves’ and ‘will-never-haves’, and thus a moral economy that has lost all its popular legitimacy. In short, then, neoliberal-automobility is a system that is both so profoundly and knottily imbricated into contemporary social life that transition is hugely difficult, but also one that is increasingly fragile as its own dynamics undermine it. It is thus both exclusive of alternatives, as superficially monolithic, and increasingly vulnerable to alternative systems insofar as these may emerge in the ‘cracks’ of the existing regime.

A Foucauldian perspective thus illuminates a systemic situation, incorporating considerations at ‘regime’ and ‘landscape’ level alike, that is considerably less ‘locked-in’ than MLP analysis would suppose. Moreover, in acknowledging the intimate connections between (auto)mobility and liberalism, this perspective also suggests that in a neoliberal conditioned context in which both systemic and individual demands for auto-mobility are entrenched and increasing, the power regime that has the best chance of replacing neoliberalism, and sponsoring a socio-tech transition, is a different but revitalized liberalism.

The key question that follows is ‘how and where could such an alternative emerge?’ and ‘what specific form could it take?’ But in its focus on strategic power relations and the knowledge-power technologies that mediate these, this perspective is able to provide significant insights into these issues as well. For it directs us to examination of socio-technological innovations as both potential power-technologies, and thence new power relations and dynamics of expansion that could actually drive a socio-technical transition; and as simultaneously, and irreducibly, mediators of *political* transition. When thought of in these terms, however, what is striking is how these challenges resonate with arguably the top

political challenge facing contemporary Chinese society – almost quite independently of the challenges of low-carbon transition and global crisis of neoliberalism. For China cannot escape Foucault’s ‘problem of circulation’ and can only postpone addressing it so long. The 36-year process of ‘reform and opening up’ has been carefully managed by the CCP in order to maintain its monopoly of state power in what is thus a domestic power regime that is constitutively committed to an essentially anti-liberal political project of party-state, not individual, power and supreme legitimacy. This process, of course, has not been without major crisis, especially the events of 1989, which resulted in an even deeper commitment to economic growth as the key to the regime’s continued political legitimacy and the effective abandonment of all socialist discourse. The result has been the spectacular – unhinged even (Wen and Li 2007) – economic growth of the past two decades, including the construction of a market economy that has created whole new classes empowered by, and dependent upon, this market economy and, of course, the historically unprecedented processes of urbanization and ‘automobilization’ that are continuing today.

Evidently, continuation of such growth in turn depends upon the deepening of these processes, in all cases intensifying the ‘problem of circulation’ and its existential significance for concomitant continuation of the current political regime. The result is that the politics of automobility are increasingly pivotal issues in Chinese domestic politics, even at the level of explicit political discourse (notwithstanding constraints on freedom of speech), with congestion, pollution, road safety, road-building and land acquisition, new hi-tech mobility risks and even parking (Economist 2012) sources of increasingly strident political demands; i.e. as widely accepted and politically-mobilizing ‘security threats’ that jeopardise, and demand redress in order to preserve, the new freedoms on which 21st century Chinese society is being actively constituted. Here, therefore, we have a perfect contemporary example – albeit with crucial concrete specificities and differences – of an *ongoing*, and not historical,

construction of a liberal power system entirely ‘premised on circulation’ (Salter 2013, 11). Indeed, with automobility increasingly central to modern government (Bærenholdt 2013), one may well expect these ever-more-intensely contested automobility politics in China to be of profound systemic significance.

This is thus to set up a dynamic of increasingly fundamental challenge to the current political regime, as the ‘problem of circulation’ poses a problem of government that is both anti-theoretical to the authoritarian logic of government constitutive of the CCP’s Leninist one-party state model and yet one to which the CCP’s *own survival* has become increasingly wed (Cf Foucault 2009, 75). This reasoning certainly licences no conclusion as to an imminent ‘liberal democratic’ revolution in China, not least because liberalism is a power regime that not only is essentially characterised by its ‘dark side’ of constitutive exclusions but has no essential connection with democratic government – historically the outcome of broader popular struggle, including *against* quintessentially liberal power regimes. Nor does this dynamic spell any reduction of state power. To the contrary, both liberalism and automobility itself – as essentially liberal, the constructed acme of individual ‘freedom’ – like the ‘free’ and ‘natural’ market (Polanyi 1957) have gone ‘hand in hand’ with a profound deepening of state power (Böhm et al. 2006, 7).

But to the extent these tensions regarding automobility politics may be constitutive of broader political economic change in China, they may also have potentially crucial effects globally regarding issues of automobility transition, political economy and liberal power regime. In short, in such circumstances, and given the sheer size and centrality of China to the global economy, a 21st century Chinese automobility could well follow the lead of its 20th century American counterpart as a major ‘vehicle’ for both the discursive-political and material-technological spread of its national hegemony as a specifically *Chinese* liberal socio-

technical and power regime. The key question, thus, is to what extent existing emergent trends and experiments regarding automobility transition in China show evidence of power technologies and relations that could underpin such a turnaround and actualize these emerging systemic possibilities.

Disruptive Innovation as Political Force?

Disruptive innovation involves the social redefinition of existing technologies by developing “cheaper, easier-to-use alternatives to existing products or services often produced by non-traditional players that target previously ignored customers” (Willis, Webb and Wilsdon 2007, 1; Christensen 1997) and/or their use in novel contexts and combinations. In the first instance, therefore, a disruptive innovation may offer *lower* functionality than existing products according to established social definitions of what the product ‘is’ or ‘does’. But by offering them at lower cost and possibly with new combinations of functions, a new market is opened that may – in time, as the disruptive innovation itself improves– entirely disrupt the established market. The classic case here is the digital camera.

Disruptive innovation is thus intrinsically – intelligible only as – *socio*-technical innovation. It also resonates with a consistent insight of innovation studies (including MLP literature) regarding the likelihood that transition may well originate in innovations that appear peripheral, small or otherwise unpromising from the perspective of the incumbent regime (Elzen, Geels and Green 2004). The significance of disruptive innovation here, however, concerns the particular strengths of Chinese businesses in such disruptive innovation (Zeng and Williamson 2007; Breznitz and Murphree 2011), including regarding low-carbon innovations; and regarding automobility, in electric two-wheelers (E2W) especially. These companies have been built on offering consumers hugely popular variations of existing

products, thereby establishing a source of revenue that, in turn, seeds increased R&D expenditure and further innovation, and thus further growth.

This thus presents a striking contrast with the utter failure to date of the hi-tech, proprietary EV model supported by government. While EVs have struggled to make any sales at all and remain much more expensive than conventional ICEs, hence dependent on government subsidies, E2Ws are now effectively ubiquitous in China, with some 120 million on the roads by 2010 (Weinert et al. 2008). Their appeal is as a low-cost, speedy (maximum speeds can reach 40-50 km/h) and ‘nimble’ form of transport able to weave through congested streets and onto and off pavements. The E2Ws that are the best sellers in this huge ‘spontaneous’ market are also themselves Chinese brands. And as electric and smaller, lighter and more mobile, hence much more energy efficient, the E2W promises significant ‘low-carbon’ benefits over the ‘car’, including the EV. Moreover, this success has not only been in the absence of any government support but rather in the face of increasing regulation and penalties, with the E2Ws officially banned now in several major Chinese cities (e.g. Beijing, Fuzhou or Shenzhen).

The most important consideration regarding E2Ws is their potential for social redefinition of the very idea of the ‘car’. Several of China’s E2W disrupters, such as Lüyuan, were explicitly founded as a route towards the future construction of other EVs and are already experimenting with further forms of vehicle (such as 3-wheelers) (Tyfield, Jin and Rooker 2010). The form of these larger vehicles is open to radical redesign, since an electric drive train removes the engine and transmission of an ICE around which the rest of the car is built. Developing EVs from E2Ws particularly enables innovators to explore disruptive possibilities, rather than start from the current design of the ‘car’. This is particularly clear when set against the growing practice of *shanzhai* or ‘knock-off brands’: the tinkering of

small garages with existing cars to convert them to electric vehicles (Wang 2011) that is widespread in Chinese cities and focuses on small vehicles, often 3-wheelers. And, conversely, this ‘game-changing’ innovation is now attracting the attention of established car companies. At the Shanghai Expo in 2010, GM-SAIC displayed its EN-V bubble car (Economist 2010), which cannot be easily classified as either an EV or an E2W since it sits two people side-by-side but has only two parallel wheels, which gyroscopically raise the vehicle up into a balanced position when the engine is on. The possibility for enabling new consumer-attractive and potentially politically significant automobility freedoms via E2Ws is thus clear.

The focus in this paper, however, concerns the potential *political* implications of such disruptive innovation, regarding these mobility innovations as new *knowledge-power technologies* and thus the power relations and emergent coalitions and self-identified subjectivities they may condition. How can/does disruptive E2W innovation contribute to the political and cultural transition that is a key aspect of socio-technical transition?

Attending to this problem first highlights a key constraint to the otherwise optimistic story of disruptive innovation told in purely socio-technical systems terms. Such disruptive innovation will remain a niche, however big, unless it is capable of transforming the existing politics and cultural discourse (and accumulation regime from a CPE perspective) of the automobility system. This political reorganization was relatively simple for the paradigm cases of disruptive innovation, such as the digital camera, in that the dispositifs and power relations involved rendered individual consumer choice relatively free to migrate from old to new technologies (e.g. the low costs and inconvenience of replacing your Polaroid for the camera in your phone). Only an attention to power, however, can distinguish disruptive

innovation concerning automobility and its chances of successfully seeding a system transition.

From this perspective we may also consider anew why E2Ws have been so penalized and excluded by current Chinese regulation. This should be something of a conundrum, given the potential political economic benefits of this industry for China, both directly and indirectly via the enhanced urban mobility (or novel freedoms) they afford. Yet the problem of E2Ws is not merely economic or a matter of innovation policy, but the crucial question of contemporary Chinese politics discussed above, namely the problem of circulation; a problem of governing-managing ‘freedom’ vis-à-vis ‘security’. E2Ws are not just ‘off the radar’ of the Chinese policy imagination and existing power networks as a ‘small’ and insignificant (‘backward’ even) technology set against the continuing commitment to the global neoliberal (hi-tech , high-IP) innovation model. But also, and more importantly, the E2W is itself ‘off the radar’ as precisely a nimble, quick and cheap – hence available to all (‘and sundry’!) – form of transport. While the CCP is thus ever-more fundamentally committed to automobility, E2Ws are not merely a useful demotic spread of automobility but rather power-technologies affording potentially *dangerous* and *uncontrollable* automobility. Hence the ubiquitous justification – amongst state officials and citizens alike – of measures against E2Ws in terms of ‘public security’, i.e. precisely the Foucauldian language of security of the population and a danger to the systemic functioning of circulation: whether as the cause of traffic accidents and collisions with pedestrians, theft (of and using silent E2Ws) and even, paradoxically, causing congestion.

Focusing on the current ‘uncontrollability’ of E2W automobility as a major political challenge – and, of course, a social-discursive construction within these strategic power plays – for its broader socio-technical and political impact, however, points to a set of

complementary technological developments in automobility innovation that could be key sites for exploration of emerging transition: namely the increasing incorporation of ICTs and web 2.0 into vehicles, as the car shifts from a predominantly mechanical to electronic device. This suggests the “transformation of the car, from a device essentially used to deliver personal mobility and freedom of travel, to a device to *protect and connect* people within an increasingly urbanized and congested spatial environment” (Wells, Nieuwenhuis and Orsato, 2013, 136, emphasis added), i.e. as technologies of security and freedom respectively.

Combined with a disruptive model of the vehicle itself, however, – a combination that is all the more likely given the expanded engineering possibilities described above – one can readily imagine a productive and positive feedback loop between the ICT-based and vehicle-focused redefinition of the ‘car’. For instance, the former opens up possibilities for efficient, seamless coordination of intermodal (and possibly shared) journeys, thereby further transforming the meaning of and technological needs of a ‘car’: no longer a *privately* owned vehicle displaying one’s personal status and of sufficient size to accommodate the occasional family holiday, say. Moreover, regarding the crucial issue of the cultural and affective politics and subjectivities of automobility, the increasing integration of ICTs can transform the experience of the vehicle so that one does not actually need to *own* the ‘car’ for it to be immediately transformed into one’s ‘home’, perhaps via a smart card that tailors the in-car environment to one’s own tastes (music, radio stations and satnav settings, cloud-based desktop for driverless working or even scent).

A focus on power and Foucauldian technologies of freedom and security also highlights the role in such a transition of the various ongoing crises of automobility: crises in mobility itself and its implications for continued economic growth (and hence personal autonomy and state legitimacy); in coordination of mobility (viz. congestion and road safety); and in

environmental pollution (most intensely regarding air pollution but also, if more indirectly, GHGs and the visible effects of climate change and instability). And it does so not as a 'landscape' that is a merely passive or only slowly and indirectly responsive context, but as active and dynamically responsive strategic discursive resources. For, on the one hand regarding enhanced 'freedom', these new ICT power-technologies afford specific metrological and epistemic capacities – capacities that become evident to the consumer only where they are incorporated into affordable technologies of movement – that thereby begin to address these existing systemic dysfunctions and so cast them in a more striking light, that in turn serves to legitimize and demand these new innovations further. And, on the other hand regarding 'security', the increasingly undeniable backdrop of these crises renders as 'common sense' the need to accept the 'rational' power technologies that will (or rather demonstrably *do*) manage and eliminate the 'dangerous' practices that threaten public security. Hence a new moral discourse associated with these mobility-connecting-securing technologies emerges, regarding the responsibility and public duty, and not just private benefit, of travelling by web 2.0 and ICT-connected, electronically coordinated and electric, low-emitting vehicles.

Most importantly, though, is that the development of the disruptive E2W's seeded by the specific ('2.0') power technologies they incorporate would transform the *social, cultural and political* standing and respectability of the industry, its financial and political backers and its consumers. From peripheral tinkerers and the 'dangerously mobile poor', 2.0-E2Ws would come to be symbols of national economic standing on the global stage, 'modernity' and 'progress', 'responsible' mobility and saviours of the national and global environment. As such, E2W disruptive innovation would thus afford the coming together of a 'greening' of urban mobility, a new cultural discourse and emergent political coalition of (specifically Chinese) producers/innovators fundamentally committed (i.e. as their *raison d'être*) to an

urban mobility transition – currently a key political absence (Geels, Dudley and Kemp 2013, 354).

It is absolutely crucial to notice, however, that in all the respects just described the ‘representative’ or ‘universal’ agent tacitly presumed in this account is not just any Chinese citizen but rather a very specific – and politically pivotal – constituency: the rising ‘middle class’, or more specifically the young, male, urban, educated, online and (comparatively) well-paid who would be particularly enabled by such changes and, conversely, are already greatly over-represented in the emerging class empowered by and for automobility politics and protest. Such dynamics, of course, *construct* a new qualitative constituency and social subjectivity that thereby constitutes a positive feedback loop of renewed, additional and more empowered demands for *further* such socio-technical innovation.

Moreover, those left out, given enduring problems of digital divide and ICT access, use and competence, may well not just be neglected but come to be positively discriminated against, as examples of what is increasingly defined as ‘irresponsible’ and ‘dangerous’ mobility; i.e. ‘security threats’ that ‘bring upon themselves’ the rationally punitive policing of their dangerous mobilities. In this way, thus, socio-technical mobility transition also involves the construction of a newly excluded and delegitimated group, now defined as a social problem that is legitimately disempowered, not least by a deepening exclusion from mobility.

Finally, these transformations of E2Ws may also augur a convergence of tendencies that could even render a *political* transition much more conceivable. On the one hand, the emerging ‘middle class’ political coalition could also thereby forge a new Gramscian historic bloc: the key political agent in the intractable challenge of transforming the Chinese state, and in ways that specifically and constitutively attend to optimizing the emerging mobility system, hence directly tackling the problem of circulation that epitomizes this existential

challenge to the current Chinese state apparatus. As this group, however, is both limited in size and constituted by the ‘winners’ of contemporary Chinese society, this may well involve merely an opening up of the reins of state power to a broader constituency than an ideologically desiccated ‘communist’ party, rather than any fundamental ‘democratic’ revolution or Jasmine Spring. And on the other hand, integrating ICT-based technologies of security into E2Ws would also substantially allay the current political objections to E2Ws and the empowerment of their users, not only transforming them from publicly proscribed to normatively obligatory mobility technologies, but also thereby presenting the means by which growing personal autonomy *for a specific ‘responsible’ section of society* may be rendered utterly compatible with – indeed, dependent upon – continuing and increased state surveillance. In such circumstances, a ‘liberal 2.0’ shift in Chinese politics may become not only irrepressible, but also perfectly digestible from the perspective of the existing power regime.

Conclusions

Beset by multiple crises, transformation of the system of automobility is increasingly urgent, especially in China. But the option chosen by policy and business, namely electric cars, is stalling, even as the technology has experienced a supposed watershed on a global scale (Orsato et al. 2013). A socio-technical perspective, such as MLP, allows identification of brighter possibilities regarding disruptive innovation around E2Ws and potential redefinition of the car. But both the problems facing transition and the full societal implications of the latter are significantly illuminated by a Foucauldian-inspired CPE perspective that goes beyond MLP in two key respects: regarding its productive ‘power to’ conception of power, which affords analysis of qualitative socio-technical change as it emerges in real-time, not just *post hoc*; and, inseparably, the crucial importance of transformation in the specific form

of (liberal) power regime, thereby bringing issues of ‘landscape’ into the heart of the analysis. Substantively, then, this highlights the profound political, cultural, institutional and political economic change, both within China and at a global scale, that a transition in the socio-technical automobility system may well need to comprise.

Given acknowledgement that the technologies of freedom underpinning the new socio-technical and political regime will also be technologies of security, however, this leads to one final, but crucial, advantage of this perspective over the MLP, namely its capacity to identify and then empirically examine in detail emerging normative issues associated with the emergent socio-technical-power system. For a key normative question for critical scholarship of the ‘low-carbon’ societies of the 21st century may now be formulated: what new and self-reinforcing socio-cultural *distinctions* of ‘in’ and ‘out’ is the new e-automobility (in China) producing, as these emerging power technologies interact strategically with existing social power relations, *their* problems and crises and the responses to these? *How and who* does it exclude? It is in the light of the emerging evidence in response to these questions, then, that strategic responses of optimal political impact can be formulated in the hope of securing not just low-carbon socio-technical futures – not least regarding (auto)mobility – but also socially just, equitable and convivial ones.

References

- Bærenholdt, Jørgen Ole. 2013. “Governmentability: The Powers of Mobility.” *Mobilities* 8 (1): 20–34.
- Banister, David. 2008. “The Sustainable Mobility Paradigm.” *Transport Policy* 15(2): 116–131.
- Birtchnell, Thomas and Javier Caletrío. 2014. *Elite Mobilities*. Abingdon: Routledge.
- Böhm Steffen, Campbell Jones, Chris Land and Mat Paterson. 2006. “Introduction: Impossibilities of Automobility.” *Sociological Review* 54 (s1): 1–16.

- Boston Consulting Group. 2011. *Powering Autos to 2020: The Era of the Electric Car?* Boston: BCG.
- Breznitz, Dan and Michael Murphree. 2011. *Run of the Red Queen*. New Haven: Yale University Press. Chen, Q, S. Liu and F. Feng. 2004. *The Coming of the Auto Age in China*. Beijing: China Development Press.
- Christensen, Clayton. 1997. *The Innovator's Dilemma*. Cambridge, MA: Harvard Business School Press.
- Climate Group. 2008. *China's Clean Revolution*. Beijing & London: The Climate Group.
- Cohen, Maurie. 2010. "Destination Unknown: Pursuing Sustainable Mobility in the Face of Rival Societal Aspirations." *Research Policy* 39: 459-470.
- Cohen, Maurie. 2012. "The Future of Automobile Society: A Socio-Technical Transitions Perspective." *Technology Analysis & Strategic Management* 24 (4): 377-390.
- Dean, Mitchell. 2010. *Governmentality: Power and Rule in Modern Society*. 2nd ed. London: Sage.
- Diken, Bulent and Carsten Laustsen. 2005. *The Culture of Exception*. London: Routledge.
- Elzen, Boelie, Frank Geels and Ken Green, eds. 2004. *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy*. Cheltenham and Northampton, MA: Edward Elgar
- "The bubble car is back: cheap, small and simple – an idea from the 1950s bubbles up again", *The Economist*, September 30 2010, <http://www.economist.com/node/17144853>
- "No parking", *The Economist*, March 24 2012, <http://www.economist.com/node/21551084>
- Feng, W, S. Wang, W. Ni and C. Chen. 2004. "The Future of Hydrogen Infrastructure for Fuel Cell Vehicle in China and a Case of Application in Beijing." *International Journal of Hydrogen Energy* 29: 355-367
- Foucault, Michel. 2004. *Society Must Be Defended*. Translated by David Macey. London: Penguin.
- Foucault, Michel. 2009. *Security, Territory, Population: Lectures at the Collège de France 1977-1978*. Translated by Graham Burchell. Basingstoke: Palgrave Macmillan.
- Foucault, Michel. 2010. *The Birth of Biopolitics: Lectures at the Collège de France 1978-1979*. Translated by Graham Burchell. Basingstoke: Palgrave Macmillan.
- Gao, P, A. Wang and A. Wu. 2008. *China Charges Up: The Electric Vehicle Opportunity*. New York: McKinsey Global Institute: http://www.mckinsey.com/locations/greaterchina/mckonchina/pdfs/China_Charges_Up.pdf

- Geels, Frank. 2002. "Technological Transitions as Evolutionary Reconfiguration Processes: a Multi-Level Perspective and a Case-Study." *Research Policy* 31(8/9): 1257–1274.
- Geels, Frank. 2005. "The Dynamics of Transitions in Socio-Technical Systems: A Multi-Level Analysis of the Transition Pathway from Horse-Drawn Carriages to Automobiles (1860-1930)." *Technology Analysis & Strategic Management* 17(4): 445-476.
- Geels, Frank. 2012. "A Socio-Technical Analysis of Low-Carbon Transitions: Introducing the Multi-Level Perspective into Transport Studies." *Journal of Transport Geography* 24: 471-482.
- Geels, Frank and René Kemp. 2013. "The Multi-Level Perspective." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 49-79. Abingdon: Routledge.
- Geels, Frank and Johan Schot. 2007. "Typology of Sociotechnical Transition Pathways." *Research Policy* 36(3): 399-417.
- Geels, Frank, René Kemp, Geoff Dudley and Glenn Lyons, eds. 2013a. *Automobility in Transition?* Abingdon: Routledge
- Geels, Frank, René Kemp, Geoff Dudley and Glenn Lyons. 2013b. "Preface." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, xiii-xv. Abingdon: Routledge.
- Geels, Frank, Geoff Dudley and René Kemp. 2013. "Findings, Conclusions and Assessments of Sustainability in Automobility." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 335-373. Abingdon: Routledge.
- Girardet, Henri. 2004. *CitiesPeoplePlanet*. Chichester: Wiley-Academy.
- Goodwin, Katherine. 2010. "Reconstructing Automobility: The Making and Breaking of Modern Transportation." *Global Environmental Politics* 10 (4): 60-78.
- International Energy Agency. 2011. *Oil Market Report*, Paris: IEA, 12 October, <http://omrpublic.iea.org/currentissues/full.pdf>
- Jessop, Bob and Ngai-Ling Sum. 2006. *Beyond the Regulation Approach: Putting Capitalist Economies in their Place*. Cheltenham: Edward Elgar
- Kemp, René, Frank Geels and Geoff Dudley. 2013. "Introduction." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 3-28. Abingdon: Routledge.
- Kern, Florian. 2011. "Ideas, Institutions, and Interests: Explaining Policy Divergence in Fostering 'System Innovations' towards Sustainability." *Environment and Planning C* 29: 1116-34.

- Law, John. 1991. "Power, Discretion and Strategy." In *A Sociology of Monsters*, edited by John Law. London: Routledge.
- Lemke, Thomas. 2011. *Foucault, Governmentality, and Critique*. Boulder, CO: Paradigm Publishers.
- Meadowcroft, James. 2009. "Engaging with the Politics of Sustainability Transitions." *Environmental Innovation and Societal Transitions* 1: 70-75.
- National Bureau of Statistics of China (NBS). 2005. *Statistical Communiqué of the People's Republic of China on the 2004 National Economic and Social Development*. Beijing: NBS. http://www.stats.gov.cn/was40/gjtjj_en_detail.jsp?channelid=4920&record=37
- NBS. 2011. *Statistical Communiqué of the People's Republic of China on the 2010 National Economic and Social Development*. Beijing: NBS. http://www.chinaero.com.cn/english/statistical_data/03/93313_3.shtml
- Orsato, Renato, Marc Dijk, René Kemp and Masaru Yarime. 2013. "The Electification of Automobility." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 205-228. Abingdon: Routledge.
- Paterson M, 2007, *Automobile Politics: Ecology and Cultural Political Economy*. Cambridge: Cambridge University Press.
- Rajan, Sudhir Chella. 2006. "Automobility and the Liberal Disposition." *Sociological Review* 54 (s1): 113-129.
- Salter, Mark B. 2013. "To Make Move and Let Stop: Mobility and the Assemblage of Circulation." *Mobilities* 8 (1): 7-19.
- Sheller, Mimi. 2013. "The Emergence of New Cultures of Mobility: Stability, Openings and Prospects." In *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 180-201. Abingdon: Routledge.
- Shove, Elizabeth and Gordon Walker. 2007. "CAUTION! Transitions Ahead: Politics, Practice, and Sustainable Transition Management." *Environment and Planning A* 39: 763-770.
- Smith, Adrian and Andy Stirling. 2007. "Moving Outside or Inside? Objectification and Reflexivity in the Governance of Socio-Technical Systems." *Journal of Environmental Policy and Planning* 8(3-4): 1-23.
- Smith, Adrian, Jan-Peter Voß and John Grin. 2010. "Innovation Studies and Sustainability Transitions: The Allure of the Multi-Level Perspective and its Challenges." *Research Policy* 39: 435-448.
- Sperling Daniel and Deborah Gordon. 2009. *Two Billion Cars*. Oxford: Oxford University Press.

- Tyfield, David. 2012. "A Cultural Political Economy of Research and Innovation in an Age of Crisis." *Minerva* 50(2): 149-167. doi: 10.1007/s11024-012-9201-y
- Tyfield, David. 2013. "Transportation and Low-Carbon Development." In *Low-Carbon Development: Key Issues*, edited by Franke Urban and Johan Nordensvard. London: Routledge.
- Tyfield, David and John Urry. 2012. "Greening China's Cars." *CeMoRe Working Paper*, Lancaster: Lancaster University.
- Tyfield, David, Jun Jin and Tyler Rooker. 2010. *Game-Changing China: Lessons from China about Disruptive Low-Carbon Innovation*. London: NESTA.
- Urry, John. 2004. "The 'System' of Automobility." *Theory, Culture and Society* 21(4/5): 25-39.
- Urry, John. 2009. *Mobilities*. Cambridge: Polity.
- Urry, John. 2013. *Societies Beyond Oil*, London: Zed.
- Van Bree, B., G. Verbong and G. Kramer. 2010. "A Multi-Level Perspective on the Introduction of Hydrogen and Battery-Electric Vehicles." *Technological Forecasting and Social Change* 77(4): 529-540.
- Wang, J. 2011. "The Shanzai Electric Car Revolution in China", <http://blog.p2pfoundation.net/the-shanzai-electric-car-revolution-in-china/2011/06/03>
- Wang, Tao 2013. [], *Tsinghua-Brookings Centre*, Beijing.
- Wells, Peter, Paul Nieuwenhuis and Renato Orsato. 2013. *Automobility in Transition?*, edited by Frank Geels, René Kemp, Geoff Dudley and Glenn Lyons, 123-139. Abingdon: Routledge.
- Weinert, J., J. Ogden, D. Sperling and A. Burke. 2008. "The Future of Electric Two-Wheelers and Electric Vehicles in China." *Energy Policy* 36: 2544-2555
- Wen, Dale and Minqi Li. 2007. "China: Hyper-Development and Environmental Crisis." *Socialist Register 2007*: 130-146.
- Willis, Rebecca, Molly Webb and James Wilsdon. 2007. *The Disrupters*. London: NESTA.
- Winebrake, James, S. Rothenberg, J. Luo and E. Green. 2008. "Automotive Transportation in China: Technology, Policy, Market Dynamics, and Sustainability." *International Journal of Sustainable Transportation* 2: 213- 238
- World Bank. 2011. *The China New Energy Vehicles Program*. New York: World Bank.
- Zeng, Ming and Peter Williamson. 2007. *Dragons at your Door: How Chinese Cost Innovation is Disrupting Global Competition*. Cambridge, MA: Harvard Business School Press.