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Transforming urban waste into sustainable material and energy usage: the case of Greater Manchester (UK)

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ABSTRACT

Networked infrastructures such as waste, energy, water and transport are integral to sustainable urban transformation. They are closely linked to urban growth and underpin the economic, social and environmental performance of modern cities. At the same time places shape the transformation of such complex infrastructural systems. Effective waste management contributes significantly to public health, environmental sustainability and economic development and it is an inherently urban challenge. Combining insights from urban studies with research on 'systems innovation' and 'sustainable transitions', this paper deals with a transformation towards a more sustainable waste management system in an urban setting. More specifically, the paper describes how Greater Manchester (UK) underwent a transformation from a relatively simple landfill model to a highly complex, multi-technology waste solution based on intensive recycling and composting, and sustainable energy usage. The case is relevant because the UK has long been seen as a laggard when it comes to sustainable waste practices. The 1999 EU landfill directive exerted great pressure to change waste practices in the UK. Against the national trend of incineration with energy recovery, Greater Manchester opted instead for a solution that was deemed more innovative and sustainable, but which involved overcoming significant technological, political and financial challenges. The paper investigates the process that led to this purposive transformation, characterized by a mix of political vision, stakeholder engagement, economies of scale, and the ability of waste disposal managers to gather expertise, resources, political influence and commitment at multiple levels of governance.

1. Introduction

Pressure for a more sustainable management of resources has intensified as a result of the inexorable global trend toward urbanization. As large users of natural resources and major producers of pollution and waste, cities are associated with significant environmental problems and challenges. Yet cities are also places where novel responses are developed to solve them. Indeed, as Jane Jacobs (1969) has claimed, most innovations have been made in cities. They provide scale, proximity and network advantages facilitating the development and adoption of technologies that enable environmental improvements (Monstadt, 2007). The sheer scale of cities thus presents an ecological risk as well as an opportunity, rendering them critical arenas for addressing the challenges of climate change (Bulkeley et al., 2011).

A vital element underpinning sustainable urban transformation is the development, governance and transformation of socio-technical systems such as waste, energy, water and transport. Such infrastructure networks play a critical role in urbanisation and environmental performance; they "provide the fundamental conduits through which modern cities operate" (Marvin et al., 1999: 93). But places also shape the development and transformation of infrastructures. Indeed, the role of cities in actively influencing socio-technical transitions is increasingly being recognised (Hodson and Marvin, 2010).

As large socio-technical systems, urban infrastructures are highly durable, path dependent, resistant to rapid change and associated with incremental, rather than radical, innovation. Change requires the active reconfiguration of complex socio-technical networks. At the same time, the emergence of a new context for urban governance, characterised by deregulation and

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liberalisation of public services provision combined with more flexible, multi-actor forms of partnerships in policy delivery, has diminished the power of cities and localities to effectively govern the transformation of urban infrastructure.

In this context, the sustainable transformation of urban infrastructure becomes a major policy challenge. This paper critically engages with this debate and, in so doing, seeks to address the following questions: how can we understand the various dimensions (institutional, political, social and technological) underpinning the transformation of urban network infrastructures? How do such transformations take place within cities? Which actors are involved in these processes and how do they collectively shape the conditions for change?

To that end, and combining insights from urban studies dealing with changes in urban governance and research on 'sustainable transitions', the paper focuses on the governance of sustainable transformation in waste management. A critical urban infrastructure, waste management contributes significantly to public health, environmental sustainability and economic development. It is also an inherently urban problem (Gandy, 1994). More specifically, this paper critically reflects on the transformation that the Greater Manchester (UK) local authority collected waste (LACW) management system underwent in the last decade, from a relatively simple landfill model to a highly complex, multi-technology waste management system based on intensive recycling and composting, and on sustainable energy usage. In what has become the largest waste management private finance initiative (PFI) project in Europe and critical to the national waste agenda in the UK, Greater Manchester adopted an ambitious solution for the sustainable management of waste, which involved considerable technological, political and financial challenges.

The case is relevant because the UK has long been an environmental laggard when it comes to sustainable waste practices. Indeed, the widespread availability of landfill sites meant that landfill was traditionally a cheap option for waste disposal as well as a convenient way of 'filling holes in the ground' (compared with recycling and recovery). Despite successive policies to move away from landfill and towards more sustainable waste management, implementing such policies has proved challenging.

The paper is organised as follows: Section two provides a background of the main conceptual building blocks underpinning our understanding of networked urban infrastructures as socio-technical systems and their implications for sustainable urban transformation. Section three reviews the specific context of waste policy and governance in the UK. This context is relevant to understanding the regulatory and policy pressures that local authorities in the UK experienced during the 1990s and 2000s and the complex challenges associated with the transformation of local waste management systems. This section is in turn the background for the empirical case of Greater Manchester, detailed in section four. The case draws from secondary analysis of policy documents, industry association reports, press releases and newspaper coverage, as well as from 18 semi-structured interviews with key actors in waste management in Greater Manchester and nationally. These included private (waste management companies, engineering, construction, large energy users) and voluntary sector (NGOs) actors, as well as local and national policy makers. Conclusions and implications for the governance of sustainable urban transformation are presented in section five.

2. Theory and concepts. Breaking path dependency in urban networked infrastructures

A vital element in the understanding of urban sustainable transformation is the development, governance and transformation of socio-technical systems such as waste, energy, water and transport. These socio-technical systems are inherently urban, their development closely linked to the growth of cities. Harvey (1996) depicts modern urbanisation as enabled by socio-technical innovations in water supply sanitations, energy supply, and transport while Melosi (2008) describes how specialized technical systems for sanitary services helped to shape the apparatus of modern cities. Furthermore, these systems are linked to many environmental problems, for they source, use, and transform huge amounts of natural resources (Monstadt, 2009).

Given the interdependency between cities and climate change on the one hand, and cities and infrastructure, on the other, the transformation of urban infrastructure plays a key role in addressing climate change (Bulkeley et al., 2011). In order to understand such transformation it is necessary to recognise the main features underpinning urban network infrastructure. Van Vliet (2012) identifies three such key characteristics. Firstly, their historical patterns of service provision have involved a shift from private delivery in the late nineteenth century to universal service provision by utilities during the second half of the twentieth century, followed by a splintered delivery from the late twentieth century. Secondly, as large technical systems (Hughes, 1983), they comprise not merely physical artifacts and technologies, but also organizational, institutional, social and cultural values that govern how they are operated. Finally, these formerly public services have been subject to contemporary policy debates on market liberalization and private participation (Van Vliet, 2012).

Given the multi-dimensional context underpinning the sustainable transformation of urban infrastructures, a number of authors (see Monstadt, 2009; also Bulkeley et al., 2011) have pleaded for an integrated framework for understanding the co-evolution between socio-technical systems and the urban context that incorporates distinct bodies of literature such as history of technology; urban governance studies and science and technology studies. Bulkeley et al. (2011) suggest that accounts of 'transitions' and of the city can complement accounts on the urban governance of climate change in understanding the political and material basis of such responses.

For instance, historical accounts such as the depiction of sanitary systems in US cities (Melosi, 2008) highlighted the symbiotic relationship or co-evolution between socio-technical systems and early processes of industrialisation. Sanitary systems were the result of intentional efforts by decision-makers to resolve problems as cities grew upward and outward. The path dependency and commitment to permanence in urban infrastructure development often locked-in specific technologies and thus limited the options for future generations. Melosi (2008; p. 2) also described how the choice among available technological solutions was place and time dependent, and informed by the "prevailing theory of the day".

Recent scholarly contributions have shed further light on the contemporary challenges inherent to sustainable urban transformation, including emerging modes of urban governance and utility restructuring. The rescaling and reconfiguration of urban processes have been described by scholars in the context of the transition from government to 'governance'. The concept of governance (Jessop, 1995; Rhodes, 1997, Stoker, 1998) embodies a radical restructuring of the state, from a situation of state dominance in the management of public functions through bureaucracy and public sector agencies, to more flexible, multi-actor forms of partnership and networking.

Urban governance accounts have highlighted the deregulation and liberalisation of public services, the sharing of responsibilities and service provision between the state and civil society, the involvement of both state and non-state actors and the emergence of multi-level forms of governance (Bache and Flinders, 2004). Scholars have also reported the replacement of managerial with

collaborative, entrepreneurial and project-based models of urban governance (Harvey, 1989; Healey, 2006) and their role in the economic regeneration of cities such as Manchester (Quilley, 2000). These changes have implications in terms of the diminished capacity and resources available to urban governments to shift urban development in a sustainable direction. In parallel, and somewhat paradoxically, there is a growing literature on urban policy and governance responses to climate change, including the emergence of new strategic players such as NGOs and community and environmental groups, and the role of policy entrepreneurs (see e.g. While et al., 2004; Bulkeley, 2010 for a review). However, much of the literature on urban governance falls short in understanding urban infrastructure networks, which tend to be relegated to "an apolitical context or backdrop, as not worthy of attention, too hidden from view (physically and/or discursively) and/or as simply the purview of engineers or technocrats" (McFarlane and Rutherford, 2008; p. 364; see also Marvin et al., 1999; Kaika and Swyngedouw, 2000).

Challenging this view and highlighting instead the critical role of infrastructure, a strand of research has focused on the transformation of utility services and its impact on cities, mainly around the question of 'splintering urbanism' (Graham and Marvin, 2001). Splintering urbanism describes the demise of the old notion of monopolistic, comprehensive, centrally directed and standardised approach to service provision and its replacement with a complex 'patchwork' of privatised companies (Marvin et al., 1999). The new logic, characterised by market liberalisation of infrastructure and the development of new technologies, is allegedly leading to a fragmentation or unbundling of networks, the segmentation of different network elements and the emergence of so-called premium networked spaces for elite groups (Graham and Marvin, 2001). Whilst the universality of this splintering process has been questioned (Coutard, 2008), it offers a useful insight to understand the limited ability of public bodies to directly steer the transformation of networked infrastructures. It also makes a contribution by pointing to the highly political nature of these processes (Bulkeley et al., 2011).

Contemporary social studies of technology have provided further key insights into the political, social and institutional dimensions underpinning the transformation of socio-technical systems, and the managing or steering of such processes of change. Drawing on case studies dealing with transport, energy, communication and healthcare, energy supply, sewerage and water infrastructure, studies on sustainability transitions emphasize the social construction of technology (Bijker et al., 1987) alongside the interactive and evolutionary nature of innovation processes (Nelson and Winter, 1982). The main focus is on 'system innovations', i.e. changes from one socio-technical system to another over a relatively long period of time. They highlight how large technical systems are relative stable but also undergo dynamic change. According to the multilevel perspective (Geels, 2002), transitions are triggered by changes at the macro or landscape level (e.g. changes in institutional, economic, political, or cultural settings) that exert 'downward' pressure on the regime or by the emergence of new technological niches that compete with the incumbent regimes and eventually outperform them and take over (Berkhout et al., 2003; Smith et al., 2010). Advocates of transition management (including Kemp and Rotmans, 2004; Kemp and Loorbach, 2006) further suggest means to actively influence regime change, via for example niche-based experiments, the creation of collective alternative visions to influence the cognitive frames of regime actors, and governance of transition arenas (Kemp et al., 1998). This has led to debates and criticisms as to whether transitions can be managed and whether deliberate intervention is possible and effective (Shove and Walker, 2007). Schot and Geels (2008) argue that steering can only be enacted 'from within' (see also Rip, 2006), for instance through addressing specific parts of the process in a stepwise learning process in order to redirect evolving dynamics toward a desired path.

A shortcoming of these approaches for the understanding of urban transformation is that they tend to be either framed at the national level or to adopt an aspatial perspective. The spatiality of transition processes, namely 'where sustainability transitions take place' (Coenen and Truffer, 2012; Raven et al., 2012) has received limited attention. Cities and regions are seen as either passive recipients of processes of change or as relatively homogeneous spaces able to influence transitions (Geels, 2011). Hodson and Marvin (2010) suggest that, rather than passively received and locally implemented, pressures for regime change are likely to be anticipated, interpreted, adapted and acted upon differently in different places. Transitions would therefore be spatially differentiated according to how problems are experienced at the local level, historical differences in urban infrastructure provision and path dependencies, and variable capacities to manage the reconfiguration of socio-technical infrastructure, including mobilisation of networks and resources internally and across scales (Hodson and Marvin, 2010).

Recent research has indeed highlighted the key role of cities and regions as strategic sites for the governance of transitions and attempts have been made to reconceptualise the role of cities in the multilevel perspective (e.g. Bulkeley et al., 2011; Hodson and Marvin, 2010). Transitions are highly contested processes that involve the co-production of particular normative visions. Such processes of contestation and problematisation are bound up in local politics and context-specific configurations of actors, infrastructure and networks. Späth and Rohracher (2010) highlight the role of regions as discursive and enabling spaces for shaping more sustainable narratives and visions for policy. Dewald and Truffer (2011) show for the case of photovoltaic markets how local responses can influence the dominant set of opportunities and constraints and therefore shape the selection environment to enable alternative, more sustainable, configurations. Such responses are shaped by institutional and network configurations at the local level, but also by capacities to enact change at various levels of governance.

To sum up, given the symbiotic relation between urbanisation, sustainability and infrastructure, understanding the transformation of urban infrastructure becomes a critical issue for combating climate change. Transformation of socio-technical networks is however gradual, shaped by inertia and path dependency. Change is driven by landscape changes, but it is crucially shaped by place-based actors, institutions and network configurations and by social and political contestation taking place at various levels of government.

3. Waste management in the UK

Waste management is a complex socio-technical system involving the sorting, collection, treatment and disposal of waste. Local authority collected waste (LACW) accounts for a small percentage of total waste in the UK (approximately 11%) and around 35% of 'controlled' waste (household, commercial and industrial.[1] However, the collection and disposal of LACW are challenging both environmentally (due to heterogeneity of waste and difficulty in sorting) and politically (constituting a sensitive area of public policy) (Davoudi, 2009). Gandy (1994) notes that difficulties in municipal waste management are particularly acute in urban areas. These include logistical difficulties (and higher costs) associated with waste collection from high rise apartments, shortage of landfill

[1] Source: DEFRA, Total UK Waste Generation by Sector. 2008 figures.

space, higher investment needs given the greater distance for waste to be transported, and limited urban space for recycling facilities (Gandy, 1994). Finally, waste management depends significantly on the involvement of consumers, householders and local communities as active participants, particularly those systems which rely on the sorting of waste by households.

As with other urban networked infrastructure systems, the socio-technical configuration of waste management has witnessed significant changes and new challenges, shaped inter alia by changes in the regulation and governance of municipal services, including increasing liberalisation of the sector and shifting private, public and civic relations. Loorbach (2007) describes how waste management in the Netherlands transformed between the 1970s and the 1990s, as a result of co-evolving changes in the regulatory and institutional context, market structure, physical technological infrastructure, individual practices and change in perceptions on waste and how it should be handled. Similar processes have shaped waste management practices in the UK.

Waste management in the UK has historically been characterised by the dominant use of landfill, and by low rates of recycling and recovery of waste (see Fig. 1). The widespread availability of sites such as disused quarries meant that landfill was a cheap option for waste disposal – and a convenient way of filling holes in the ground' – compared with recycling, composting and incineration. By 2000 around 80% of LACW was disposed of by landfill,[2] compared with much lower rates in other countries. While the use of incineration as a means for waste disposal was pioneered in cities in the UK at the end of the 19th century (with the construction of a series of furnaces dubbed "destructors") (Clark, 2007; Melosi, 2008), its use soon declined given the availability of landfill sites. During the 'energy crisis' in the 1970s incinerators were reintroduced with added energy recovery functionality, however their economic disadvantage vis-a-vis landfill, coupled with increased concerns and associated EU regulatory changes to curb air pollution, led to their widespread closure in the 1990s, reducing UK incinerator use to one of the lowest levels in the developed world (Gandy, 1994). Recycling practices have had a similarly uneven trajectory. After a shift in the policy discourse towards considering waste as a valuable resource and the introduction of statutory provisions to encourage recycling in the 1970s, local recycling initiatives declined as a result of the impact of the economic recession on waste material markets and the cost of maintaining such schemes by financially constrained local authorities. As a consequence, recycling slipped down the policy priorities, only to regain salience in the 1980s as a result of a wider sustainability agenda (Gandy, 1994; Davoudi, 2001).

Thus, for a long time, reliance on landfill and the prevalence of the discourse of 'filling holes in the ground' conditioned UK waste policy, for instance hampering any attempt to search for better spatial-ordering criteria for land use and relegating waste to a low profile and a marginal activity within the planning community (Davoudi, 2001). It also limited the exploration of alternatives (including new technologies) for waste disposal vis-à-vis other countries with less available landfill space.

A second element to consider is change in UK waste policy and governance. As Davoudi (2009, p. 139) states the majority of environmental regulatory measures introduced in Britain have originated in Europe. The discourse of the 'waste hierarchy', initially reflected in the requirements of the EC Framework Directive on Waste (WFD),[3] was incorporated to the UK waste policy agenda in the 1990s. The WFD initially introduced a four-step hierarchy (reduction-reuse-recovery-disposal), where recovery through recycling and composting were put at the same level as energy recovery through incineration (Davoudi, 2009).[4] Subsequent UK strategies and White Papers (DoE, 1995; DETR, 1999, 2000) reaffirmed the importance of waste minimisation and the priority attached to moving practices up the hierarchy, including successive targets for waste reduction and recycling. However, the difficulties of realising such aspirations were significant, resulting in a failure nationally to meet such targets (Read, 1999). The introduction of the 1999 EU Landfill Directive[5] strengthened the pressure to modify waste practices by constraining the options available for waste disposal and introducing strict targets for the amount of biodegradable municipal waste sent to landfill.[6] Additional mechanisms such as the Landfill Allowance Trading Scheme (LATS)[7] and further increases of the landfill tax escalator were introduced in order to meet diversion targets.

This shift in policy agendas had taken place in the context of a broader shift in urban governance with implications for the management of waste by local authorities. In the postwar era, municipalities were responsible for all aspects of waste management including collection, disposal, and regulation of waste. Since the mid-1970s privatisation and the introduction of compulsory competitive tendering led local authorities to become increasingly less involved in the direct provision of local waste services. Since 1985 Waste Disposal Authorities (WDAs)[8] have performed the waste management functions and duties of metropolitan county councils, which were abolished in 1986, while collection is the responsibility of waste collection authorities (WCAs). Similar to other single purpose authorities (such as the police or the fire service), WDAs are made up of elected members representing the constituent councils and initially financed from a levy on local authorities apportioned on the basis of their individual council tax[9] contribution. Privatisation implied that collection services should be contracted out to direct service organisations (DSOs) while WDAs were required to organise their waste disposal services through a partly-owned arms-length Local Authority Waste Disposal Company (LAWDC) or directly with the private sector. The regulatory function initially assigned to WDAs was transferred to the Environment Agency in 1996, leading to tensions in the coordination between regulatory and waste planning functions (Davoudi, 2001). At the end of the 1990s Regional Technical Advisory Bodies (RTABs) were set up in each region in England and Wales to produce coordinated waste strategies, comprising local waste planning, disposal and collection authorities, government agencies and business representatives. However, such regional structures were however seen as sites of political contestation lacking legitimacy and accountability, and where certain voices such as those from community and environmental groups were marginalised (Davoudi, 2009).

[2] Source: Defra. Local authority collected waste statistics. Figure for England only.

[3] The first Waste Framework Directive dates back to 1975 (75/442/EEC) and was substantially amended in 1991 (91/156/EEC) and more recently in 2008 (2008/98/EC).

[4] The 2008 WFD changed the hierarchy to a five-point one, where recycling and composting are separated from energy recovery, clearly indicating that recycling and composting were environmentally preferable to energy from waste (EfW) incineration (Davoudi, 2009).

[5] Directive 99/31/EC on the landfill of waste.

[6] Reduction of waste sent to landfill of 75% of 1995 volumes by 2010/to 50% by 2013/to 35% by 2020.

[7] Introduced in 2004, LATS set up a certain amount of BMW that each waste disposal authority was allowed to landfill in each year, allowances that Authorities are able to trade with other authorities, save or use in advance.

[8] For unitary authorities, WDAs are the same as the WCAs.

[9] As per levying Bodies (General) Regulations of 1992. Council Tax is the local taxation collected to part fund services provided by local government England, Scotland and Wales.

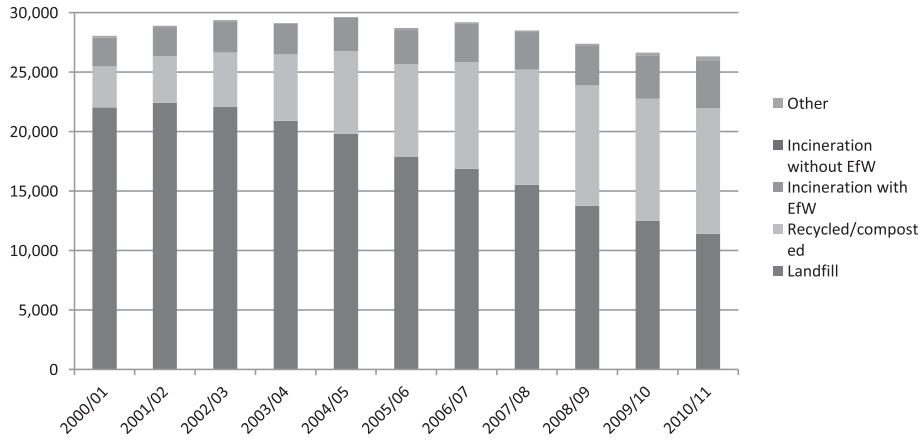

Fig. 1. Local authority collected waste management methods in England. 2000/01 to 2010/11 (tonnes). Source: DEFRA.

Rescaling processes in waste governance in the UK such as the creation of RTABs were motivated by a need to provide better policy coordination and efficiency in the delivery of waste infrastructure but also to respond to the restructuring of the waste management industry from small to large scale multinational corporations (Davoudi, 2009)[10]. Competitive tendering, regulatory changes and significant increases in household numbers had offered major opportunities for private firms, stimulating significant restructuring and consolidation of the industry during the 1980s and 1990s, as well as increased technological sophistication. Large firms could benefit from economies of scale and afford investment in new treatment technologies, and were able to influence the policy agenda and lobby for more efficient, off-the-shelf solutions (Gandy, 1994; Boyle, 2002; Keynote, 2010).

The effect of these changes was a more limited power of local governments over the management and regulatory dimensions of waste management and an increased role of market forces in the spatial distribution of waste-management facilities. In addition waste policy was characterised by the dispersal of funding, planning and regulatory responsibilities between several government departments and agencies across different tiers, more complex networks of relationships, and a consequent lack of a single and coherent policy, with some confusion as to 'who did what' (Davoudi and Evans, 2005; Davoudi, 2009). This background clearly conditioned the UK's response to the pressures of the 1999 Landfill Directive, with a focus on diversion through the development of infrastructure and a relative neglect of strategies for prevention (Bulkeley and Gregson, 2009).[11] More precisely, the policy debate seemed to be "moving inexorably towards the profitable capital intensive option of incineration with energy recovery" (Gandy, 1994; p. 3). Investment in new generation incinerators, considered to be safer than their older counterparts, more efficient, less polluting and a low cost source of energy, was seen as a good way forward, potentially complementing recycling as part of an integrated waste strategy (House of Commons Environment, Food and Rural Affairs Committee, 2005). The waste hierarchy placed EfW incineration at the same level as recycling and composting, making incineration a favourable option in policy terms. Environmental groups and commentators on the other hand argued that incineration crowded out recycling and waste minimisation and warned of a 'wasted opportunity'[12] to reverse the UK's poor track record in waste practices (Murray, 1999; Davoudi, 2001).

Given this backdrop, investment in new incineration technologies for energy recovery constituted an attractive 'technological fix', which did not require a significant shift in waste practices. Alternative models based on intensive recycling and waste reduction required changing "whole systems" (Murray, 1999; p. 21). More sustainable systems were however constrained by market, organisational, institutional and technological barriers (COSU, 2002). Missing markets for recyclates rendered recycling an expensive option. The paucity and unreliability of waste data meant that collection authorities and central government had very little knowledge of the growth and composition of specific waste streams. Further, institutional fragmentation and poor policy coordination, the traditional split between collection and disposal systems and the way waste disposal services were paid for did not incentivise recycling and recovery solutions. Local government funding arrangements made it difficult to raise the finance needed to develop recycling infrastructure. The use of Private Finance Initiative (PFI) schemes to fund waste projects made it less risky to support large infrastructure projects underpinned by long-term contracts than small-scale recycling initiatives (COSU, 2002). The dominant institutional, cultural and professional culture in waste management was geared towards mass disposal operations, making it difficult to shift towards "light touch, multi-stream recovery systems" (Murray, 1999; p. 94). Finally, besides incineration, there was little experience in the UK of waste technologies, including more flexible and recycling intensive solutions such as Mechanical and Biological Treatment (MBT) and Anaerobic Digestion (AD), the latter subject to regulatory uncertainty as to whether organic waste could be defined as biomass and therefore eligible for renewable energy subsidies.

Indeed, despite the high level of public objections to incineration, often leading to rejections of planning applications and huge delays, most local waste PFIs in the UK involved the use of EfW plants (Dundas and Wilson, 2009). Any attempt to reverse this trend would require, according to Gandy (1994; p. 3), "not just a shift in policy but also […] a more active role for governments in

[10] Boyle (2002) reports a similar process of rescaling of waste governance in Ireland, with the formation of groupings of local authorities to achieve economies of scale. Such strategy, he argued, had the effect of creating new and viable markets for 'super dumps' and thermal treatment facilities.

[11] Bulkeley and Gregson, 2009 report how most policies and initiatives in the 2000s have been directed at materials recovery through the creation of new infrastructures with very little attention paid to waste minimisation and prevention strategies, confined to a few initiatives run by the Waste and Resources Acton Programme (WRAP).

[12] Another waste opportunity, The Guardian, 25/05/2000.

environmental protection at local, national and international levels". The challenges associated with such an active role were evident in the case of the Greater Manchester waste PFI described in the next section.

4. The Greater Manchester (UK) waste transition

The Greater Manchester Waste Disposal Authority (GMWDA) is the largest waste disposal authority in the UK, serving over 2 million residents of the conurbation across the Greater Manchester (North West of England) municipalities of Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside and Trafford (see Fig. 2 below), and currently managing around 1.1 million tonnes of waste a year, some 5% of the UK's total of LACW.

Much of this waste has in the last decade ended up in landfill with only a fraction being recycled. Recycling rates were very low even by UK standards: Melville and Munck (2005) note how the North West of England had in 2000/1 the highest concentration of local authorities with low (10% or less) recycling rates (see Fig. 3), with Liverpool and Manchester achieving only 2% and 3% respectively.

Given such high volumes of waste and low recycling rates the pressure was high for the waste authority to adapt to the new regulatory standards. Unsurprisingly, the first solution proposed by the GMWDA in the late 1990s in response to the new landfill bio-diversion targets was to replace the existing landfill-based system managed by Greater Manchester Waste Ltd (GMWL), the GMWDA arm's-length waste management company, with a new contract involving the construction and operation of a series of EfW incineration plants.[13] The GMWDA and the landfill operators viewed incineration as the easiest and cheapest way to meet landfill bio-diversion targets.

Environmental groups, local councillors and the public joined forces in rejecting the incineration plan outright. On the one hand, environmental groups such as Friends of the Earth (FoE) rejected any form of incineration however modest. A key argument in this initial resistance to an incinerator solution was that it becomes necessary to 'feed the beast', i.e. volumes of waste must be maintained for the life span of the incinerator, in some cases up to 40 years. An incineration strategy thus 'locks in' waste production. The relationship between Manchester City Council and environmental groups had become rather hostile after the announcement of the additional runway at Manchester Airport in 1997 and the protests that followed. Furthermore, as noted by Davoudi (2009), FoE were being excluded from RTABs meetings, particularly in the North West (NW) region. A small number of local politicians, on the other hand, firmly believed that waste was a resource that could be exchanged in emerging markets and an opportunity that could be exploited for the benefit of the city region, generating jobs and stimulating innovation. In addition, they feared that the rapid growth of waste flow would quickly outpace the proposed new infrastructure, with a consequent need for more incinerators.

Despite the generally low performance of Greater Manchester in recycling and recovery, experiences in community recycling had been already successfully trialled by some of the local authorities in the metropolitan area (most notably Stockport, which gained national 'beacon status'[14] for its recycling practices), and officials in those districts were particularly vocal about the need to develop a solution to the waste problem that favoured recycling and recovery. Yet recovery and recycling was a minority activity and not enforced by regulation through targets and penalties at the time. As a consequence recycling was a low priority for the GMWDA, whose organisational culture was shaped by the practice of landfill and mass disposal.

Recycling was further disincentivised by the way waste services were paid for, namely from a levy on local authorities which was apportioned on the basis of council tax contributions of individual councils. This meant that councils were not paying proportionally for the volumes they were disposing of, encouraging neither waste reduction nor recovery. The system was perceived as unfair by some councils, and the resulting tensions were a serious gridlock in reaching consensus around a coherent waste strategy. In addition, the arms-length waste company GMWL was unable to raise the necessary capital to improve facilities and raise standards. To break the deadlock, a solution was required that would be acceptable to all concerned. To do nothing was not an option considering the rate of waste increase (almost doubling between 2003–2004 and 2005–2006), with landfill disposal cost and penalties expected to escalate beyond other waste management options. This created a sense of urgency to deal with the problem.

One of the most vocal members of the group opposing the incineration plan was a Labour councillor of Manchester City Council who successfully applied for a vacant position in the GMWDA in 1999 and was elected its chair in 2001. He set out to transform the organisation from the inside, hiring new staff with new skills and new ideas, including a number of environmental consultants and the head of waste management at Stockport, and replacing old authority members over time. The authority also sought to "make the most of the expertise and resource that is available centrally" (GMWDA, 2004; p. 77), engaging in networks, strategic alliances and at times actively lobbying central government departments. As an example, new recruits included a procurement director seconded from the central government environment ministry (DEFRA), which secured not only a strong level of expertise on waste procurement but also a link to national level policy development, including forthcoming legislation consultations.

One of the first actions of the reconfigured authority was to gather consensus among the nine local authorities to move the levy system to a sliding scale based on tonnage of waste rather than council tax levels.[15] This was a step towards greater investment in recycling activities and greater coordination in collection systems across the nine municipalities and the community sector. In addition, recycling critically hinged on the willingness of residents to participate, as well as viable markets for secondary materials. Markets for recyclates did not exist locally on the scale required, and assessing the feasibility of recycling on a larger scale first required a comprehensive analysis of waste flows and composition. Such analysis, was however constrained by a lack of reliable information on the volumes, types and origins of the waste streams and recycling levels. The GMWDA mobilised a group of environmental consultants to extract and interpret evidence and a system was eventually established to collect and process waste data across the conurbation. This initial analysis provided expert confirmation of the viability of recycling on a larger scale and helped increase the buy-in of the nine member authorities.

[13] In 1995 four of the five incinerators operating in the conurbation had ceased to operate as a result of EU emissions regulations, their upgrade perceived as neither financially feasible nor cost-advantageous given the relatively low cost of landfill.

[14] The Beacon Scheme for Communities and Local Government (CLG) was a national programme operated by the Improvement Development Agency (IDeA) that identified authorities which demonstrated excellence in a particular area.

[15] The GMWDA would later lobby central government to make the case for the system to be changed nationally. It was not until 2006 that Defra introduced the legislation so that all waste in England and Wales was charged by tonnage.

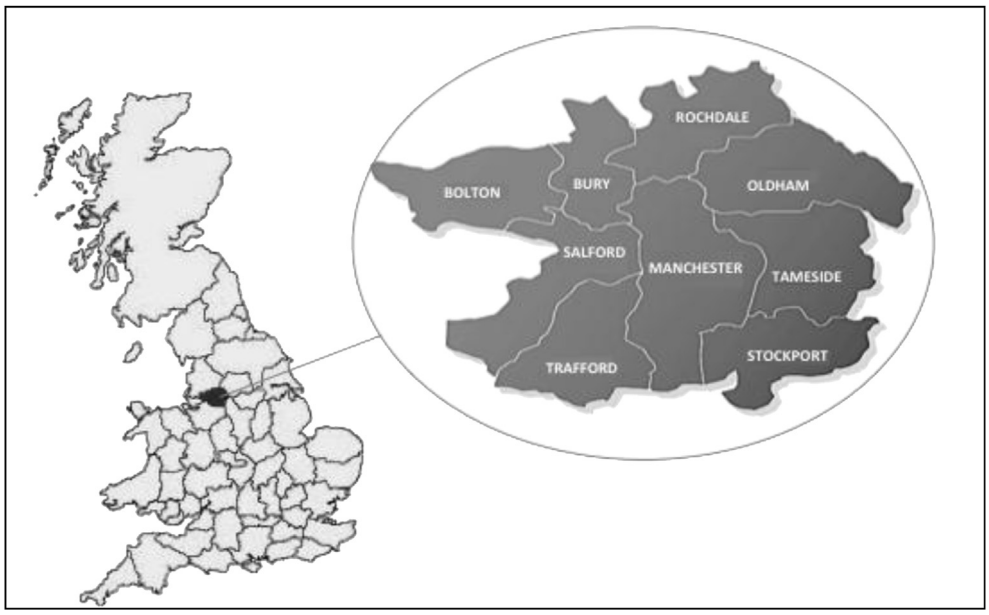

Fig. 2. Greater Manchester's local authorities served by the Greater Manchester Waste Disposal Authority (GMWDA).

Household consultations conducted during 2002 further contributed to strengthening GMWDA's aspirations to change waste practices. The consultation revealed a preference for non-incineration options and indicated a strong demand for additional investment in waste management facilities, including a source separation system. In parallel to household consultation, a review was conducted of available markets and processing capacity for recyclates and compostables. Building on early experience in Stockport, potential outlets were identified for each of the separated waste streams (paper and cardboard, textiles, metals, plastics, glass as well as local compost markets). The specific system design had to be aligned with household practices in order to boost participation but also guarantee a high quality output for emergent recycling markets. As a result of this active matching process, a compromise was finally reached on a four-stream collection system.

Early evidence based on the data collected from local authorities and initial progress in recycling performance gave the GMWDA a lead advantage nationally at a time when the UK government was starting to report on recycling and waste minimisation. It served to demonstrate that Greater Manchester was able to make a substantial contribution to delivering the national waste agenda for landfill diversion, but also to recycling and composting targets. The result was the attraction of substantial national funding (in excess of £10 million between 2002 and 2006 from DEFRA waste minimisation and recycling related funds, disproportionately more than any other WDA in the country) for investment in the provision of kerbside collection services for recyclable and compostable material and improvements in the household waste recycling centre network. This was accompanied by additional efforts to increase participation and change public perception of recycling, including information campaigns, workshops, and education centres.

The household consultation informed the 2003 Greater Manchester Waste Management Strategy (MWMS), which set a recycling target of 50% by 2020 – well above the statutory targets imposed by the government at the time – and prioritised a waste management system solution that was recycling and composting led (GMWDA, 2004). The Strategy was the basis of the business case submitted to the government to obtain PFI credits[16] and the output specification of the subsequent call for tenders inviting private companies to submit proposals for the provision of the infrastructure and the delivery of waste services.

In order to reduce perceived barriers to competition in the bidding process, the GMWDA decided to 'de facto' privatise the arms-length company (GMWL) by transferring its assets, including its 600 employees, to the winning contractor. This was a difficult transfer undertaken in close partnership with trade unions after initial strong opposition over fears of potential job cuts and involved upskilling staff in anticipation of the new system requirements while securing uninterrupted provision of waste services. A decision was also taken to aggregate the various waste services required into a larger, integrated contract in order to provide the GMWDA with sufficient market and political influence.

The expectation was that the ambitious targets (translated into contract specifications), the newly developed recycling infrastructure, the scale of the project, and a more level playing field for competition, would help shape the selection environment for the range of available potential solutions, discouraging incineration based solutions and instead attracting technologies that favoured reduction and recovery. Preferred options included mechanical biological treatment (MBT) with anaerobic digestion (AD), which were thought to offer greater flexibility and greater potential to reduce the overall volume of waste requiring final disposal. However uncertainty around MBT hinged on the final use of the residue left after the treatment process, a high calorific value fraction that could be used as a fuel (commonly known as Solid Recovered Fuel or SRF). The GMWDA (2004; p. 61) considered that, although the market for SRF in the UK was limited, "a project of this scale could stimulate the development of market solutions that could not be provided otherwise". In collaboration with the North West Development Agency (NWDA) the GMWDA undertook a review of potential off-take markets for SRF in the region, including cement kilns, paper mills, coal-fired power stations and

[16] PFI "credits" is the capital element of the project funding given by the central government to the local authority to pay the private contractor for these projects.

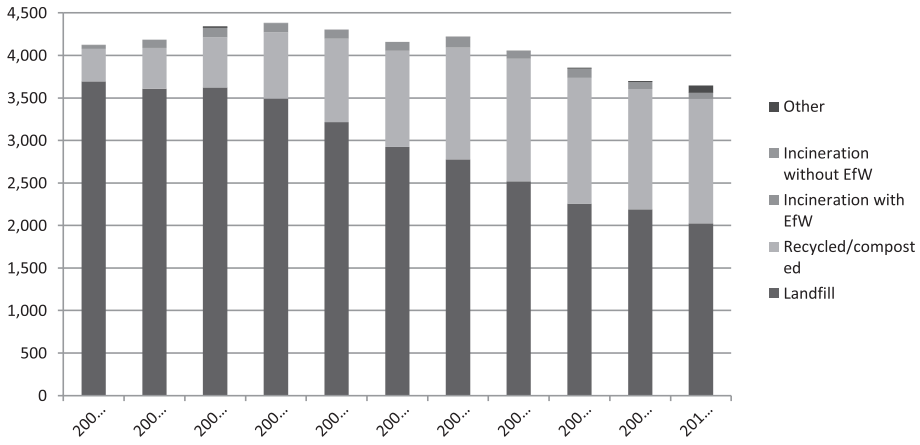

Fig. 3. Local authority collected waste management methods in the North West of England. 2000/01 to 2010/11 (tonnes). Source: DEFRA.

high-energy consumers in industry. As a result of this active search, an energy intensive, large chemical plant in Runcorn (Cheshire) committed to the construction of a combined heat and power (CHP) plant to process the fuel. In parallel, the GMWDA successfully lobbied central government to clarify the eligibility of SRF for Renewal Obligation Certificates (ROCs).[17]

Once the renewable energy incentives were in place to enable or at least not preclude an MBT based solution, the GMWDA engaged in an active campaign to secure the buy-in of the various stakeholders to the building of treatment plants. Friends of the Earth were particularly vocal in their rejection of any form of burning of waste. Some of their members were invited together with local planners and other stakeholders to join the GMWDA in their prospective visits to waste treatment plants in Europe – funded by the UK Government's Department of Trade and Industry's (DTI) inward investment programme – which helped change perceptions and reduce resistance. Engaging FoE was particularly significant considering historical tensions, as well as the exclusion of environmental groups from regional scales of governance. The involvement of the GMWDA in the central government's waste policy review (COSU, 2002) where MBT-AD was identified as a good solution also helped influence the environmental debate nationally, easing consensus at the local level. Eventually FoE gave their official backing to the MBT-AD approach, despite their preference for alternative options involving more ambitious recycling targets, and greater waste minimisation.

Active communication and engagement with planning authorities, with an emphasis on the potential for job retention and creation in the region, and the length of the procurement process, smoothed the process of securing planning permission, reducing the levels of public objection to the plants.[18] The planning application for the CHP plant in Runcorn was eased by its brownfield location and by the fact that such applications fell under national jurisdiction rather than local. The problem of transporting the SRF fuel, another potential source of public opposition (and therefore planning delays) was resolved by the possibility of rail transport enabled by the existence of railheads at the existing waste reception sites within the conurbation. Coordination with HM Treasury and DEFRA at central government was in turn instrumental in stimulating interest and competition in the banking sector in order to secure capital funding for the project. This engagement helped facilitate acceptance by a traditionally highly risk averse banking sector of a technology not used previously on this scale in the UK. Strong stakeholder engagement and buy-in proved crucial in 2008, when the financial crisis raised the possibility of the collapse of the entire PFI market. Strong local commitment and the national strategic environmental & financial importance of the project ultimately persuaded HM Treasury to step in with an additional capital injection in 2009 (complemented by additional local funds) to enable it to reach financial closure.[19]

Eventually a £3.8 billion, 25 year waste management contract was signed with a consortium of infrastructure, waste and chemical companies to provide an integrated waste management solution including recycling services, composting, MBT and AD, as well as the use of SRF for the production of steam and electricity. While facilities were not fully operational until 2013, by 2011 the process had already enabled the GMWDA to reach recycling levels of 37%. In the same time frame 50% of LACW has been diverted from landfill, a significant contribution to national landfill diversion targets[20].

5. Discussion and conclusions

Cities are vital sites for addressing the challenges of climate change. The environmental impact of infrastructure and the close link between urbanisation and infrastructure systems such as waste, water and transport, renders the sustainable transformation of urban infrastructure a major policy challenge, and so understanding the nature of such transformation is key to solving environmental problems. Understanding networked infrastructures as socio-technical systems facilitates an exploration of path dependent processes and provides insights into the challenges associated with breaking path dependence to stimulate sustainable urban transformation.

[17] ROCs had been introduced in 2002 to encourage the sourcing of electricity from eligible renewable sources and were available for non-waste organic waste, however the eligibility of SRF as source of clean energy was uncertain.

[18] Obtaining planning permission for building waste handling and waste treatment plants is notoriously difficult in the UK, so the fact that no permission was rejected or went to appeal was exceptional for a project of this scale, involving 42 facilities across 27 sites.

[19] In March 2009 the HM Treasury urgently set up a £2bn fund to bail out PFI projects that had difficulties in reaching financial close due to the credit crunch. The Manchester waste project was the only one to be finally 'rescued' given its strategic importance for meeting the landfill targets, for the waste industry, and the PFI market more generally. ("Taxpayer bails out Europe's biggest waste-to-energy scheme in Manchester", The Guardian, 8/04/2009).

[20] At the same time the volume of waste has been reduced by 25%, yet this reduction can be explained by a diversity of factors-not just policy-, including the economic crisis.

As large socio-technical systems, infrastructures are durable, highly path dependent and resistant to rapid system change. Their renewal constitutes a major governance challenge, involving complex inter-dependencies between different system elements, including new organisational configurations, changes in social practices and new technologies. In addition, such transformation increasingly takes place in a 'splintered' urban environment, characterised by flexible, multi-actor, public and private partnerships for the delivery of public services.

In this paper we have aimed to critically engage with this debate by trying to understand the various dimensions (institutional, political, governance, social and technological) underpinning the transformation of urban network infrastructures; and the actors and processes shaping the conditions for change. We have done so by looking at the particular case of waste management and through a 'real life' empirical case study of a radical transformation in an urban setting. Specifically, the paper investigated the process leading up to the transformation of the Greater Manchester municipal waste system. Our focus was on the particular transformation process, namely the efforts to shift institutional, cultural and professional practices, collectively representing a break from the dominant national trajectory.

The evolution of waste management in the UK provides a good illustration of the governance challenges associated with shifting urban infrastructure in more sustainable directions. Over the last decade, processes of market liberalisation in waste have intensified, resulting in an increased role of market forces and a more limited power of local government to directly steer the transformation of waste management systems (Gee and Uyarra, forthcoming). This has been accompanied by a rescaling of waste governance and an increasingly complex regulatory, planning and policy regime characterised by multi-actor, public and private partnerships for the delivery of waste services.

This context conditioned national and local policy responses to the new regulatory environment created in the UK as a consequence of the 1999 Landfill Directive. Indeed, pressures to move away from landfill led discussions over waste practices to gravitate towards the adoption of energy from waste treatment solutions, considered a convenient 'technological fix' that involved little change to the existing regime. More sustainable systems based around recovery and reduction were severely constrained by complex market, organisational, institutional and technological barriers. However landscape pressures are likely to be anticipated, problematized and acted upon differently in different places, local responses potentially disrupting, shaping or altering national trajectories (Hodson and Marvin, 2010). Given the scale of the conurbation and thus the volume of waste managed by the GMWDA, the pressures to modify waste practices were felt in Greater Manchester in a particularly acute way. The urban configuration of waste infrastructure, path-dependent practices characterised by a strong dependence on landfill and very low recycling rates, and a dominance of landfill operators, explain the initial incineration-led strategy. However, the firm opposition to such plans opened a window of opportunity for new ideas to be considered.

New ideas included a vision of working towards zero waste which were shared by a small number of actors. This involved the move away from landfilling or incineration and towards the promotion of waste reduction and intensive recycling. This was a contested position, facing opposition from the old regime as well as from alternative sustainable visions. Discursive and political dynamics unfolded whereby these political actors sought to gain consensus and alignment with their envisioned direction of travel. In particular, they sought to overcome a problematic relationship with previously excluded environmental groups by engaging them in the process and ultimately securing their buy-in. Consultations, awareness raising, data gathering, site visits and demonstration activities were used to mould expectations, build legitimacy and gain the support of various local stakeholders (households, planners, council officials, environmentalists, trade unions), ultimately codifying the zero waste vision into a strategy and associated performance targets.

Translating such visions into action however required not only the alignment of social interests, but also the coordination and mobilisation of capability and resources at multiple scales and the reconfiguration of the organisational and institutional context for action, including the endogenous renewal of GMWDA. Mobilisation of resources involved forging or strengthening actor-networks at various levels of governance. Realising that many of the issues and challenges in Greater Manchester reflected national issues, the GMWDA actively drew upon resources and expertise at the regional (e.g. NWDA, RTAB) and national (e.g. DEFRA, HM Treasury, DTI, DETR, Environment Agency) levels in order to anticipate and influence policies, gather resources, shape perceptions of various key stakeholders and reduce resistance to their strategy. Such efforts involved intense lobbying, resource mobilisation and agenda setting with a variety of stakeholders in the system.

A mix of political vision, scale economies, stakeholder engagement, market shaping and the ability of waste disposal managers to gather expertise, resources and political influence at multiple levels of governance enabled the WDA to overcome market, technological and other barriers to system transformation. By influencing the institutional and regulatory framework conditions, the GMWDA was able to alter the dominant set of opportunities and incentives, and therefore shape the selection environment to enable alternative, more sustainable, configurations. What ensued was a deliberate effort to steer a sustainable system transformation from within (Schot and Geels, 2008; Rip, 2006) by actively de-assembling the previous regime and re-assembling a new one.

In so doing, the GMWDA deviated from the dominant trajectory and orchestrated an alternative one. Along the way, the GMWDA influenced UK waste policy and shaped national institutional and regulatory frameworks, including changes in the levy payment systems and regulatory changes to enable new markets for SRF. However, the end configuration of the waste system in Greater Manchester was unique, a product of time specific regulatory and policy pressures and incentives and Greater Manchester's own response to those pressures, shaped by local networks, existing urban infrastructure, user demands, local institutional design and political objectives. Such a unique system is therefore not directly replicable in other parts of the UK.

To conclude, this case illustrates the symbiotic relationship between innovations in infrastructure systems and the urban environment. It provides evidence of urban governance challenges associated with attempts to work towards more advanced environmental solutions. It also provides an account of a purposive attempt to overcome the inertia of socio-technical networks and urban governance arrangements through various forms of intervention. The case shows how system innovations are triggered by external pressures and incentives which are felt differently at different times and in different places; how they are driven by collective visions of sustainability mediated by unique, place-specific urban conditions such as political culture, resources, existing infrastructure and local path-dependencies; and how they are conditioned by different abilities to reconfigure socio-technical infrastructure through the mobilisation of resources and actor networks internally and across governance scales.

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