Contesting Urban Metabolism: Struggles Over Waste-to-Energy in Delhi, India

Federico Demaria

Institute of Environmental Science and Technology, Autonomous University of Barcelona, Barcelona, Spain and Centre for Studies in Science Policy, Jawaharlal Nehru University, Delhi, India; federico.demaria@uab.cat

Seth Schindler

Department of Geography, University of Sheffield, Sheffield, UK; s.schindler@sheffield.ac.uk

Abstract: Recent scholarship on the materiality of cities has been criticized by critical urban scholars for being overly descriptive and failing to account for political economy. We argue that through the conceptualization of urban metabolisms advanced by ecological economists and industrial ecologists, materialist and critical perspectives can be mutually enriching. We focus on conflict that has erupted in Delhi, India. Authorities have embraced waste-to-energy incinerators, and wastepickers fear that these changes threaten their access to waste, while middle class residents oppose them because of their deleterious impact on ambient air quality. We narrate the emergence of an unlikely alliance between these groups, whose politics opposes the production of a waste-based commodity frontier within the city. We conclude that the materiality and political economy of cities are co-constituted, and contestations over the (re)configuration of urban metabolisms span these spheres as people struggle to realize situated urban political ecologies.

Resumen: Los estudios recientes sobre la materialidad de las ciudades han sido criticados por los investigadores urbanos por ser demasiado descriptivos y no dar cuenta de la economía política. Argumentamos que a través de la conceptualización de los metabolismos urbanos de los economistas ecológicos y los ecólogos industriales, las perspectivas materialista y crítica pueden enriquecerse mutuamente. Nos centramos en el conflicto que ha estallado en Delhi, India. Las autoridades han introducido incineradoras y los recicladores temen que este cambio amenaza su acceso a los residuos, mientras que los residentes de clase media se oponen debido al impacto negativo en la calidad ambiental del aire. Explicamos la aparición de una improbable alianza entre estos grupos, cuya política conjunta se opone a la producción de una nueva mercancía, no quieren que los residuos sean una nueva frontera de la mercantilización dentro de la ciudad. Llegamos a la conclusión de que la materialidad y la economía política de las ciudades son co-constituidas, y las disputas por la (re)configuración de los metabolismos urbanos abarcan ambas esferas al luchar la gente por alcanzar y situar determinadas ecologías políticas urbanas.

Keywords: environmental justice, political economy, Southern metropolises, urban political ecology, waste, commodity frontier

Residents of south Delhi's Okhla area were delighted to see what they thought was the season's first snowfall. But they were enraged after realising that it was toxic ash from a large waste-to-energy plant (*Rediff News* 2012).

Antipode Vol. 48 No. 2 2016 ISSN 0066-4812, pp. 293–313 doi: 10.1111/anti.12191

The above quote is from an online news article about a waste-to-energy incinerator in Delhi, India. It highlights the importance of materiality—in this case toxic ash—in the lives of the people residing in the neighborhood adjacent to the incinerator. Indeed, the euphoria elicited when residents thought they were witnessing the season's first snowfall quickly gave way to visceral rage as the neighborhood was engulfed in hazardous particulate matter. The story of Delhi's first waste-to-energy plant could be narrated as a case of neoliberalism *par excellence*—a series of non-transparent deals led to the transfer of land and the right to build the incinerator from a parastatal institution to a large corporation owned by a sitting Parliamentarian. However, this narrative would omit the emotional and physical toll that the incinerator has taken on nearby residents, who launched a protracted campaign to have the plant closed. This movement is focused on materiality, as the constant exposure to particulate matter has become a defining feature of the everyday lives of nearby residents and has produced a collective anxiety. In addition to middle-class residents, waste-to-energy technology has faced opposition from workers in the informal waste management sector and NGOs that lobby on their behalf. "Wastepickers" collect, segregate and sell waste to recyclers, and to them the incinerator represents a bitter economic injustice because it threatens to dispossess them of a resource, ie waste (Wilson et al. 2006). An incipient alliance has emerged between middle class residents and wastepickers in opposition to the incinerator and it obtains in spite of the fact that they are motivated by "conflicting rationalities" (Watson 2003). To the former this struggle is material in essence as they seek to reduce their exposure to waste on the grounds that it poses a health risk, while the latter are engaged in a political economic contestation whose aim is to defend a source of livelihood.

This research speaks to ongoing scholarly debates surrounding the need to expand the scope of urban political ecology on the one hand (Heynen 2014), while situating it within local contexts on the other (Lawhon et al. 2014). To this end we draw on industrial ecology and ecological economics (see Newell and Cousins 2014), for which materiality lacks agency but must be accounted for and can be quantified; in this particular case we focus on the composition, volume, and metabolic density of Delhi's waste. This approach demonstrates that neither political economy nor materiality can be considered context as they are always already co-constituted. It is distinguishable from classical urban political ecology's (UPE) use of the metabolism metaphor as a heuristic device employed to better understand and critique capitalism, as well as "second wave UPE" wherein post-humanist approaches focus on the distribution of agency across complex assemblages composed of human and non-human actants (see Heynen 2014).

The politics surrounding metabolic flows gives rise to antagonisms and alliances that are not necessarily re-enactments of twentieth century struggles; instead of epic contestations between capital and organized labor, or demands for recognition and rights that characterize so-called "new" social movements, metabolic conflicts erupt and alliances are formed and fragment as people struggle to define their "place" in, and relation to, dynamic situated urban political ecologies. Metabolic contestations in cities in the global South—and waste conflicts in particular—involve struggles over value and livelihood *as well as* health and wellbeing. While it is clear

that political opportunities are fostered or foreclosed according to the resources that serve as metabolic inputs and the ways in which they are processed (eg coal vs oil) (Mitchell 2011), we show that the same is true of outputs (eg interring waste in landfills vs incineration).

This paper is divided into four sections. In the next section we introduce our conceptualization of urban metabolism, which is influenced by industrial ecology and ecological economics. In the third section we describe Delhi's solid waste management (SWM) system, explain how it has been transformed in recent years, and show how this has provoked opposition which coalesced into an unlikely alliance. In the fourth section we conclude by exploring the implications of unlikely alliances for environmental politics in general.

Materiality and the Making of Urban Metabolisms

The conceptualization of cities as metabolisms has a long history (Decker et al. 2000; Geddes 1885; Giampietro et al. 2012; Martinez-Alier 1987; Mumford 1938; Wolman 1965—see Newell and Cousins 2014 for an overview) and over the course of the past decades there has been a "virtual explosion" (Fischer-Kowalski 1998:62) of research on urban metabolisms. Ecological economists and industrial ecologists have been at the forefront of this revival, and to these scholars urban metabolisms are "exchange processes whereby cities transform raw materials, energy, and water into the built environment, human biomass, and waste" (Castan Broto et al. 2012:851). The aim of many of these researchers is to quantify material inputs and outputs, and capture the biophysical processes that result as resources are assembled and transformed, and waste is produced (Daniels and Moore 2001; Fischer-Kowalski et al. 2011; Kennedy et al. 2007). This approach has been influential in policy surrounding environmental sustainability which is increasingly geared toward the quantification of material flows and biophysical processes (While et al. 2010). For example, the United Nations Environmental Program's recently published report entitled *City-Level Decoupling*: *Urban Resource Flows and the Governance of Infrastructure Transitions*:

> makes the case for examining cities from a material flow perspective, presenting the city as a living organism with a dynamic and continuous flow of inputs and outputs as its "metabolism", while also placing the city within the broader system of flows that make it possible for it to function (UNEP 2013:2).

Urban metabolisms can remain stable over long periods of time, but they are inherently subject to change according to resource availability, technological innovation and political contingency. Joan Martinez-Alier (2002) has demonstrated that the chance of social and political conflict is heightened when metabolic flows are suddenly increased, interrupted or redirected. While most scholarship focused on the quantification of material flows within a given metabolic system has largely failed to explicitly show how power relations condition the (re-)configuration of metabolisms (for exceptions, see Anguelovski and Martinez-Alier 2014; Martinez-Alier et al. 2010), urban political ecologists have put these contestations front and center. For these scholars urban infrastructure is a manifestation of power relations

within and between cities, as it facilitates the throughput of metabolic flows, their transformation and unequal distribution (Kaika 2006; Kaika and Swyngedouw 2000; Keil and Graham 1998; Swyngedouw 1996; Swyngedouw and Heynen 2003). Accordingly, UPE demonstrates that metabolic processes cannot be understood in isolation from governance regimes that determine the social relations of production, division of labor and distribution of resources (Heynen et al. 2006; Swyngedouw and Heynen 2003). In much of this scholarship there is an *a priori* assumption that metabolic flows are determined by political economic processes, so in contrast to quantitative analyses of urban metabolisms UPE tends to employ the metabolism metaphor as a heuristic device through which capitalism can be understood and critiqued. For example, Matthew Gandy (2002:8) criticizes earlier scholarship on metabolism whose "metabolic conceptions of urban form tend to neglect the flow of capital ... [which] represents the most powerful circulatory dynamic in the production of modern cities".

Urban political ecology is witnessing a number of robust debates, and Heynen (2014) traces the emergence of "second wave UPE" which draws on post-humanism to critically analyze the role of things. Much of this scholarship employs the Deleuzoguattarian concept of "assemblage" to describe the rhizomatic coming together of humans and non-humans, and/or it examines the ways in which actants mediate durable actor-networks (see Bennett 2010; Farias and Bender 2010; Harris 2013; Holifield 2009; Lancione 2013; McFarlane 2011a, 2011b; Meehan 2014; Ranganathan 2015; Shaw and Meehan 2013). Much of this scholarship is not geared toward understanding or critiquing capitalism, but rather it seeks to develop a deeper understanding of everyday life and cities (see Derickson 2014; Heynen 2014). In this vein Lawhon et al. (2014) argue that UPE risks universalizing particular Northern ecologies because of its unwavering focus on the power of capital. They suggest that scholarship on African urbanism can inform the development of a *situated* urban political ecology (SUPE), by beginning with local context, identities and everyday practice, and then using non-Northern epistemologies to explain actually existing ecologies. Rather than generating a critique of capitalism whose remedy is systemic change, they argue that this situated UPE can lead to "radical incrementalism" (Pieterse 2008). This approach has already paid dividends by situating actually existing metabolic flows, the production of landscape and urban space in the context of local contingencies, ecologies and politics (Ernstson 2012; Lawhon 2013; Silver 2014). Importantly, for these authors African urbanism is not meant to replace Marxian-inspired UPE as an alternative universal epistemological framework, but by situating UPE they hope to expand the "range of urban experiences to inform theory on how urban environments are shaped, politicized and contested" (Lawhon et al. 2014:498).

We are sympathetic to the argument that UPE should be broadened theoretically and situated empirically, and we argue that this can be achieved by developing a deeper understanding of the contested nature of urban metabolisms. Colin McFarlane (2013:500) argues that peering at a city through a "metabolic lens" offers the potential to multiply "the potential sites of intervention, from water pipes, drains and power stations to laws, policies and officials, widening the objects of analysis and the epistemology of social change". However, this potential remains

largely unfulfilled in much UPE scholarship because of the way in which capital is portrayed as the primary determinant of urban metabolisms. By embracing an understanding of metabolism influenced by industrial ecology and ecological economics whose focus is actual material flows, we seek to develop a situated understanding of waste in Delhi at the core of which is a complex relationship between its materiality (eg volume, composition, density and its biophysical transformation) and political economy (eg ownership, access and value struggles). In this urban metabolism non-human entities lack agency but must be accounted for in a literal sense because a change in their character or quantity, or the way in which they are acted upon, can profoundly impact political economic processes. We do not simply seek to "empower" materiality as a determinant of political economy, rather we demonstrate that materiality and political economy are dialectically related and co-constitute urban metabolisms. While a change in one or the other may disrupt a stable metabolic configuration in particular instances, there is no moment when either serves as context or structure. Ultimately, the coevolution of materiality and political economy transforms urban metabolisms and as a result political opportunities are fostered and foreclosed.

Delhi's Urban Metabolism

Waste management in Southern metropolises is a multi-billion dollar industry that is increasingly attracting the attention of large-scale institutional investors (Bank of America Merrill Lynch 2013). This is due to the fact that the volume of generated waste, its metabolic density and proportion of recyclable materials (and thus calorific value) has increased in many cities (Martinez-Alier et al. 2014), and as a result there are new opportunities for capital accumulation through incineration (World Bank 1999). In most cases municipal officials are left with little choice but to process/dispose of waste within cities given an increasing metabolic density of waste, difficulties establishing new landfills within cities and high costs transporting waste to landfills in outlying areas (D'Alisa et al. 2012).[1] Incineration appears an attractive option because it "eliminates" waste while it also produces energy.

Indian cities exhibit these trends, and they are also being transformed through complex economic, political, social and ecological processes that are contested in a range of spaces and ways by numerous actors (Shatkin 2014). Powerful local actors typically embrace and work towards grandiose visions of urban transformation, the pursuit of which significantly impacts cities and urban residents as slums are demolished and cityscapes are remade (Benjamin 2008; Dupont 2010; Ghertner 2011; Goldman 2011; Schindler 2014a). Nevertheless, visions of "world class" cities remain perpetually postponed because they are contested by a bewildering array of actors who employ a range of techniques in places that vary from courts and corporate boardrooms (see Bhan 2009; Searle 2014) to everyday politics that unfold on the street (see Chatterjee 2011; Datta 2013; Doshi 2013; Schindler 2014b).

Recent scholarship demonstrates that urban ecologies in India are embedded in these broader processes of transformation and contestation, and serve as a field upon which the middle class and the poor are engaged in political and material

struggle. Negi (2010) has narrated an "environmental turn" in Indian politics in which courts have ruled in favor of public interest litigation (PIL) initiated by middle class residents, which forces municipal authorities to demolish slums and close so-called "hazardous industries" in the name of environmentalism. While Mawdsley (2004:81) cautions against essentializing a single environmentalism of the middle class, she notes that "the middle classes exert a disproportionate influence in shaping the terms of public debate on environmental issues". Meanwhile, the poor have resisted displacement and metabolic reconfiguration that threaten their livelihoods. A recent edited volume by Rademacher and Sivaramakrishnan (2013:30) presents "the emergence of a set of conflicts that involve not merely the material conditions of urban life—security, green spaces, municipal services, unimpeded mobility through the city—but also the very people, mostly slum dwellers, who might undermine these conditions".

The political positions taken by these groups are not immutable, and the transformation of urban India's dynamic metabolism can foster unlikely alliances between them. We draw on a combined 16 months of experience collaborating with organizations working in Delhi's waste management sector—one an NGO and the other a waste workers' trade union—in 2011–2012. During this time we interacted with key stakeholders involved in everyday struggles over waste management, and we augmented these experiences with semi-structured interviews during follow-up visits in 2013 and 2014.

Solid Waste Management in Delhi

The metabolization of waste in Delhi—ie the production, throughput and processing of waste—is best understood as a single production network comprised of two interlinked value chains, one formal and the other informal (see Figure 1). The generators of waste—eg households and firms—are legally obliged to deposit their waste at a transfer station where it becomes the property of the municipal government. These transfer stations are typically approximately 15 m^2 and are located throughout the city in both residential and commercial areas. From the transfer station onwards the collection, removal and disposal of waste is the responsibility of municipal authorities.

The formal waste management system has historically been overburdened and it is complemented by a large informal value chain that channels waste into the formal and informal recycling sectors. The relationship between the formal and informal value chains is mediated by approximately 150,000–200,000 wastepickers (Chaturvedi and Gidwani 2011:131) who gather recyclable waste at various leakage points along the formal value chain (see green arrows in Figure 1). They segregate it and then sell it to small-scale junk dealers, who, in turn, sell it to wholesalers (see Agarwal et al. 2005; Gidwani and Reddy 2011; Gill 2010; Hayami et al. 2006). These wholesalers ultimately sell recyclable waste in bulk to formal and informal recycling firms. This system has had a mixed record; as of 2005 approximately 15% of Delhi's waste was recycled (Agarwal et al. 2005) while approximately 20–30% remained uncollected and was illegally dumped or burned in the open

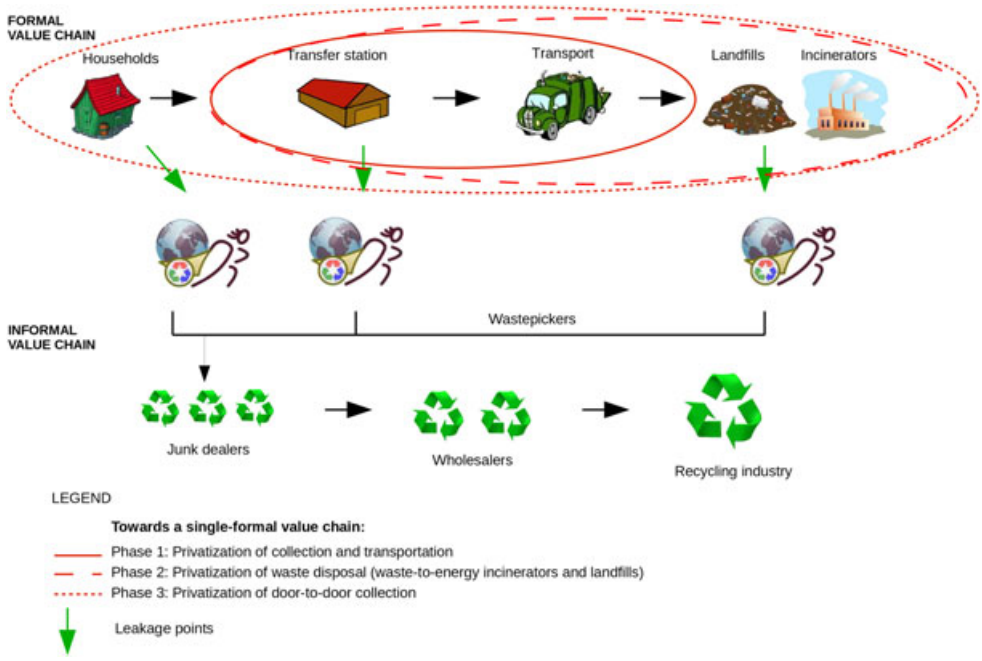

Figure 1: Flow diagram of waste management in Delhi and the three stages of the policy shift (source: authors)

(Talyan et al. 2008). What is indisputable, however, is that the informal waste sector provided livelihoods of last resort to thousands of people (Gill 2010). Most wastepickers collect approximately 50 kg of recyclable material per day, mostly plastic and paper (60% and 30% of their income, respectively), but also metals, hair and organic materials, and they earn roughly 8000 rupees per month (about $120) (AIKMM 2015).

Solid waste management in Delhi is undergoing a prolonged and thorough reconfiguration as successive phases of privatization of the formal waste management system have served to strengthen connections within the formal value chain at the expense of linkages with the informal value chain. These institutional reforms have been accompanied by the introduction of new techniques of waste processing which rework the material flows of waste and determine who is exposed to environmental hazards. These political economic and technological changes are driven by the dramatic material increase in the volume and density of waste, and a change in its composition. The roots of these material changes date back to the mid-1980s when only 8.3% of Delhi's waste was recyclable. By 2002 the proportion of recyclable waste had increased to 17.2% (see Table 1), and this compositional shift is even more striking when one considers that there was an unprecedented trebling of the amount of waste generated from 1990–2010 (see Figure 2).

Delhi's landfills struggled to absorb the material increase of waste, and municipal authorities were urgently tasked with locating new sites for sanitary landfills in order to avoid a public health crisis. Middle class residents filed numerous lawsuits that demanded authorities develop more effective SWM systems, the result of

Table 1: Physical composition (as wt%) of municipal solid waste in Delhi (source: Talyan et al. 2008)

Year	Organic	Recyclable	Inert	Total
1982	57.7	8.3	34	100
1995	38.3	12.9	48.8	100
2002	36.6	17.2	46.2	100

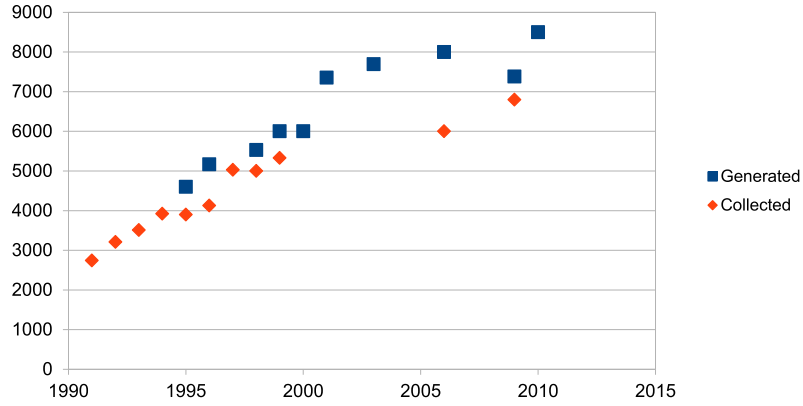

Figure 2: Generation and collection of municipal solid waste in Delhi, tons per day (1991–2011) (source: CPCB 2006; MCD 2012)

which was the creation of a number of expert committees at multiple levels of government (Gidwani 2013). Numerous policy options could have responded to the increased volume of waste in Delhi. One would have been to promote segregation of waste at the point of generation, improve collection rates and invest in sanitary landfills. This could have been complemented by institutionalizing the linkages between the formal and informal value chains with the objective of fostering recycling (see Schindler et al. 2012; WIEGO 2013). Instead, authorities embraced techno-managerial solutions which entailed transforming the production network of waste management into a single formal value chain under the control of private sector enterprises.

The privatization of waste management in Delhi has unfolded in three phases (see Figure 1), the first of which began in 2005 when municipal authorities started to contract private firms for the collection and transportation of waste from transfer stations to landfills (Chaturvedi and Gidwani 2011). Authorities opted for a second phase of privatization in which waste-to-energy plants—ie the incineration of waste rather than its burial—became the cornerstone of Delhi's waste management system. Currently two waste-to-energy plants are operational in Okhla and Ghazipur (south and east Delhi, respectively), and a third is under construction in the north of the city in Narela Bawana.

The third phase of privatization has just begun and it is geared toward developing a single value chain under control of private-sector enterprises, and this policy is driven by a material exigency because waste-to-energy plants can only produce energy from high-calorific waste. In Delhi, the calorific value of formally collected waste at disposal sites (ie after recyclable waste is removed by wastepickers) is

approximately 1000 kcal/kg (NEERI 2005), while combustion incinerators require waste with a minimum calorific value of 1500 kcal/kg. Thus, Delhi's incinerators require the elimination of leakage points whereby high-calorific recyclable waste is transferred to the informal value chain by wastepickers. In order to obtain waste with a high enough calorific value, privatization vertically integrates SWM—from collection to disposal—under the direction of a small number of large-scale enterprises. One example is a 2009 contract between the Municipal Corporation of Delhi and a subsidiary of Ramky (Delhi MSW Solutions Ltd), one of India's largest waste management firms, which grants the firm exclusive rights to collect and process waste in four zones in Delhi (Civil Lines, Rohini, Vasant Kunj and Dwarka Pappankalan).

The progressive privatization of SWM in Delhi was a response to—and made possible by—the increase in volume and metabolic density of waste, as well as a change in its composition. Privatization is not only an institutional change, but it is also a comprehensive reconfiguration of the city's metabolism as the throughput of waste is redirected and new methods to process waste are introduced. This has been contested by Delhi's middle class and wastepickers, albeit for very different reasons.

Conflict I—Wastepickers

Wastepickers began to organize politically in the 1990s. They originally sought recognition from the state and their demands centered on access to services such as healthcare and schools. Beginning in the mid-2000s struggles increasingly revolved around access to waste because the reconfiguration of Delhi's waste metabolism progressively eliminated leakage points from the formal value chain. The first struggles over access to waste erupted at transfer stations because after their privatization firms often forcibly removed wastepickers or forced them to pay a fee to continue their operations (see Chaturvedi and Gidwani 2011). One wastepicker explained (personal communication 2014):

> At first when the company came, they said that we should carry on working. But then, one by one, they started to go to the garbage bins [to collect waste]. They stated they had written permission from the municipal authority and they took control of them. Those who did not vacate them were beaten up and thrown out; the others were told that they could stay if they paid a certain sum of money.

The urgency of struggles over access to waste intensified with the announcement that waste-to-energy would become the cornerstone of SWM in Delhi. The following two comments are representative of how wastepickers typically understood the conflict as a struggle for their livelihood (personal communication 2014):

> Since we don't have any other work we are forced to do this filthy work. We are forced to pick up this waste. Still the government is trying to force us out. They want to produce electricity by burning our livelihood.

> The work of the waste-to-energy plant is to burn things. They know that [inert and organic] waste never burns. They are trying to burn things [recyclable material] from which we earn our living. Therefore, we are opposing the waste plants.

Finally, in some areas of Delhi where the door-to-door collection of waste has been privatized, wastepickers have lost access to the last remaining leakage point. A female wastepicker whose livelihood came from door-to-door collection explained (personal communication 2014):

> Since 2012 the company has started to send a four wheeler small truck to collect waste at the doorstep. Since then my revenue has already gone down of about 30 [or] 40 per cent and it's decreasing everyday. Then, sometimes the company employee offers to us the waste they collected under a payment of 100 Rupees or more per truck, but I can't afford it. Where should I go to get support?

A number of trade unions have been formed to demand access to waste, such as All India Kabadi Mazdoor Mahasangh (AIKMM), Safai Sena, Delhi Kabadi Mazdoor Sangh, and Green Flag. They have primarily (1) lobbied municipal authorities to grant wastepickers access to waste in publicly owned facilities and (2) organized networks of wastepickers in order to secure flows of waste. For example, Safai Sena (meaning "Army of Cleaners") is "a registered group of waste pickers, doorstep waste collectors, itinerant and other small buyers, small junk dealers, and other types of recyclers" that was formed in 2009.[2] It successfully outbid competitors for the exclusive rights to collect and remove waste from Delhi's three train stations in 2011. This waste then enters Safai Sena's network and it is channeled into the recycling industry. Similarly, AIKMM, formed in 2005, claims to have approximately 17,000 members in the Delhi metropolitan area.[3] Its director Shashi Bhushan explained (personal communication 2013):

> We work with a trade union perspective. We organize wastepickers to get them their livelihood and fundamental rights as citizens. If one of us faces a problem [e.g. get harassed by the police], we call 50 or more members and run in his support. In this way we have managed to stop the demand for bribes by private companies at the transfer stations in the centre of Delhi. Nobody wants to hear our voice ... no policy makers reply to our letters of complaint. So we organize demonstrations with hundreds of our members in front of the public authorities' offices and sit there until they receive us. It is the only chance for us to meet and talk to them about our demands, starting from right to waste.

Both of these unions organize rallies and demonstrations, and their demands have targeted local officials and private firms. For example, AIKMM organized a demonstration outside of the Delhi headquarters of the United Nations in 2011 to protest the inclusion of the Okhla and Ghazipur waste-to-energy plants in the Clean Development Mechanism's carbon credits scheme. The effectiveness of grassroots unions is limited, however, because they have scarce resources and many wastepickers earn a subsistence livelihood and cannot afford to spend much time attending political rallies. Furthermore, there is no legal basis for them to make a lawful claim regarding access to waste since its management is the responsibility of municipal authorities.

Trade unions are complemented by a host of social and environmental justice organizations that advocate on behalf of wastepickers, such as Toxics Watch Alliance, Hazards Center, Toxics Link, Chintan, Nidan and Global Alliance for Incinerator Alternatives (GAIA). Many of these organizations collaborated with grassroots unions

to host the Global Strategic Workshop for Waste Pickers in 2012 in Pune, in which wastepickers and activists from around the world gathered and identified privatization and waste-to-energy as the two main threats to wastepickers globally. While all of these unions and organizations consistently demand that wastepickers should have access to waste, tensions emerge regarding how they relate with private-sector firms. For example, Safai Sena's website explains that a private firm was granted exclusive rights to collect waste in a Delhi suburb, and "Safai Sena worked with them to ensure that the existing wastepickers were able to upgrade their work through becoming the doorstep collectors under the new system".[4] In other words, this union demanded that the firm hire its members as wage laborers. Alternatively, AIKMM has steadfastly opposed bargaining with private-sector firms for fear that this could legitimize privatization. Its website demands that privatization be halted altogether and most recently its demands have focused on door-to-door collection: "Informal sector waste collectors should be given exclusive rights for door-to-door collection at the housing cluster and neighborhood levels. The private sector companies should be kept out of door-to-door waste collection".[5]

All of the NGOs that advocate on behalf of wastepickers link their demands to both environmental sustainability and social justice, but tensions have emerged over which issue to prioritize. Some of the organizations frame their opposition to waste-to-energy plants as an environmental struggle while for others it is first and foremost an issue of social justice and their demands are focused on livelihood issues. For example, an organization called Chintan released a report that framed waste-to-energy as a livelihood issue that should "not be accepted blindly without regard to the *socio-economic context*" (Chaturvedi et al. 2012:17). Alternatively, an NGO called Toxics Watch Alliance[6] has focused on waste-to-energy's environmental impacts, and its director Gopal Krishna (2013) explained that "this plant will emit large quantities of hazardous emissions (such as dioxins) due to burning of MSW [Municipal Solid Waste], and will profoundly affect the health of the people living in the surrounding areas and environmental for all times to come in future".

In summary, issues surrounding access to waste have become increasingly politicized, and a number of trade unions and NGOs have emerged to contest the reconfiguration of Delhi's waste metabolism. Since wastepickers operate informally they cannot make lawful claims to waste, and this may explain why some organizations committed to social justice frame their opposition to waste-to-energy plants in environmental terms.

Conflict II—Middle Class Residents

Informal dumping grounds proliferated in large Indian cities in the 1980s as government subsidies for commercial fertilizers reduced demand among farmers for organic waste, which they had hitherto used as fertilizer (Almitra Patel, personal communication 2014). Economic growth in the 1980s and 1990s resulted in the widespread use of cheap plastic, and a concomitant boom in construction increased the volume of inert waste. This prompted the emergence of a middle class mobilization demanding more effective SWM with the slogan "clean up and flourish or pile up and perish"

(Almitra Patel, personal communication 2014).[7] Legal proceedings were initiated against municipalities for their failure to handle solid waste and to enforce anti-dumping laws. The petitioners ultimately prevailed and the Supreme Court appointed a committee that drafted India's first Municipal Solid Waste (MSW) Rules in September 2000 (PIL No.W.P. [C] 888 of 1996 Almitra H. Patel vs Union of India and Others). The lead petitioner in the case Almitra Patel explained that:

> this regulation advocates that "wet" food wastes and "dry" recyclable wastes should not be mixed at the source (household or commercial level), so that the organic waste can be composted, while the dry waste can be left to the informal sector's ragpickers and *kabadiwalas* for recycling (personal communication 2014).

The avenues available to India's middle class to make lawful claims against poorly performing municipal governments have proliferated as the *MSW Rules* have given municipal governments more responsibility. Almitra Patel claims that the *MSW Rules* are "a powerful weapon that any Indian citizen can use to demand improved performance and accountability".[8]

Most middle class residents in Delhi either supported or failed to notice the initial wave of privatization of the city's SWM system. Complaints among middle class residents only surfaced in instances where private firms failed to improve waste collection, but there was not opposition to privatization *per se*. Thus, for most middle class Delhi residents waste becomes a political issue when the failure of municipal authorities to meet legal obligations regarding its handling and management threatens to contaminate their surroundings. This explains why the reconfiguration of Delhi's waste metabolism engendered resistance among middle class residents of neighborhoods located near the proposed waste-to-energy plants, who were fearful that the plants would contribute to the rapid deterioration of air quality.

The first waste-to-energy plant in Delhi was built in a populated area called Okhla and it is India's largest. The second plant is somewhat smaller and is located in an area called Ghazipur which is somewhat peripheral but nevertheless densely populated. The proponents of the Okhla waste-to-energy plant conducted an environmental impact assessment in 2006, and unsurprisingly they concluded that the plant would not have serious adverse environmental impacts. The assessment explained that although there would be continuous emissions of particulate matter and ash, the plant will only have a "minor negative impact" on ambient air quality.

Local residents claim that they were not informed about the project in its early stages and they formed the Okhla Anti-Incinerator Committee in 2009 to oppose the waste-to-energy plant. They sought to mobilize support through social media and they organized public actions such as street plays.[9] Consistent with earlier middle class mobilizations regarding environmental issues, the opposition demanded accountability from public officials and insisted that the plant posed an environmental hazard. One of the leaders of the movement explained that municipal authorities (personal communication 2014):

> are not interested in solving the waste crisis at all, all that rhetoric on technology and development is nonsense. They have a hidden agenda, the waste crisis is just used as an excuse. These are acres of prime real estate land. They [Jindal Ecopolis] got it for a few Rupees and will sell it for several crores of Rupees in the future.

These allegations of corruption are consistent with an ongoing anti-corruption movement in Delhi, yet even if proven true this is unlikely to halt the operations of the waste-to-energy plant. Furthermore, demands to have the plant relocated were futile because city officials could simply assert their authority to determine land-use on publicly held land. Thus, rather than lobby to have the plant relocated, the Okhla Anti-Incinerator Committee was forced to contest the waste-to-energy plant on the grounds that it was inherently unsafe. During interviews our repeated attempts to focus the discussion on the political economy of opaque land deals were rebuffed. Indeed, the political economy of corruption was narrated as a matter of course, but what motivated residents to take to the streets and demonstrate was the feeling that particulate matter produced by the plant is all-pervasive and inescapable. Thus, these residents are first and foremost focused on materiality; particulate matter has invaded their bedrooms, and implanted itself in their clothes, blankets and even bodies. As one of their leaders explained: "This is a question of the health of our children and elders and we cannot compromise. Most of us have been living in this area for decades and cannot relocate" (personal communication 2013).

Residents met with the acting Minister of Environment and Forests, Jairam Ramesh, and he promised to launch an inquiry into the approval of the plant given its proximity to residential areas. The stakes were raised in the meantime when the plant began operating and promptly covered the surrounding neighborhoods in a blanket of ash. The *Deccan Herald* reported that the area "is slowly turning into a toxic gas chamber" (Sethi 2012). Residents had already launched a number of legal challenges to the plant, and a member of the Okhla Anti-Incinerator Committee explained that "we are now planning to file a case for human rights violation at the National Human Rights Commission. We feel our fundamental rights have been violated, in particular the right to life and the right to a clean environment". The PIL that the residents filed in 2009 made its way to the Delhi High Court in 2013. The presiding justices opted to refer it to India's recently created National Green Tribunal, which was created in 2010 "for effective and expeditious disposal of cases relating to environmental protection".[10] The case is currently pending.

Unlikely Alliances and the Institutionalization of Waste Politics

An incipient—and at times uneasy—alliance has been forged between wastepickers and middle class residents in their opposition to Delhi's waste-to-energy plants. The Okhla Anti-Incineration Committee has highlighted the threat to wastepickers' livelihoods posed by the Okhla waste-to-energy plant through social media, and a more collaborative relationship has developed in the contestation over the Ghazipur waste-to-energy plant. In March 2012 a demonstration was spearheaded by resident welfare associations from neighborhoods located near the Ghazipur plant in collaboration with AIKMM *The Hindu* (2012). In a letter to inform Delhi police of their intention to stage a demonstration, AIKMM General Secretary Shashi Busan explained that "local residents are concerned about the potential injurious

consequences to the health of their families due to the plant toxic emissions (ie carcinogenic dioxins and furans). Instead, wastepickers are concerned about the loss of their livelihood, as they fear that recyclable materials will be burnt in the incinerator."

The resident welfare association and AIKMM subsequently formed the Ghazipur Anti-Incinerator Committee, and issued a press release (2012) with four demands:

1. Stop all on-going work on the Ghazipur incinerator immediately.
2. Dismiss all waste-to-energy incinerator project proposals.
3. Adopt participatory and decentralized waste management policies that do not disproportionally force any single community to live with the city's waste.
4. Recognize and support the informal waste recycling sector by adopting policies that include the waste pickers.

The Okhla Anti-Incinerator Committee took notice and happily announced that "Ghazipur has picked up the baton!" There was evidence that the thinking of Okhla residents had evolved from being narrowly focused on closing the Okhla plant, to more broadly focused environmental justice issues. One very active member of the Okhla Anti-Incinerator Committee explained this shift (personal communication 2013):

> Earlier some people used to say "shift it, shift it" [to another location] but I said no. From both the cases [Okhla and Ghazipur waste-to-energy plants] these technologies are not good. Either we should need some good technologies or we should use some other way [to safely process waste] ... They should find some other ways to dispose of garbage.

Another active member of the Okhla Anti-Incineration Committee is a professional journalist who has publicly defended the interests of wastepickers (Makri and Devraj 2015):

> For rag pickers, rubbish is a resource and a survival strategy. Even under unhealthy conditions, their work earns them enough to support their families. And in the absence of a municipal recycling system and segregation of waste at source, such as people's homes, they play a key part in the city's waste management.

While Okhla residents demonstrate a willingness to explore alternative metabolic configurations which can serve as the basis for augmenting wastepickers' access to waste, in general the two groups have remained at arm's length. In contrast, wastepickers and Ghazipur residents have cooperated closely by holding joint demonstrations and issuing joint statements. The primary explanation for these differences is the socio-economic status of residents in Okhla and Ghazipur, respectively. Many of the former are affluent professionals capable of engaging in formal politics and litigation. Prior to the completion of the incinerator they were able to secure a much publicized visit from the erstwhile Minister of Environment Jairam Ramesh, in which he promised to review the procedure whereby environmental clearance was issued to the plant (*The Hindu* 2011). They were also able to gain an audience with Delhi's erstwhile Chief Minister Sheila Dikshit, and in addition to

engaging public officials and leveraging media coverage, Okhla residents can afford to wage a lengthy legal battle.

Ghazipur residents tend to be from a lower socio-economic status (eg low-level officials, small entrepreneurs and low-level office workers) whose demands do not command the attention of public officials or the media. Thus, they are forced to take to the streets and agitate, and AIKMM has proven a valuable ally because of its ability to mobilize wastepickers. The relationship between AIKMM and Ghazipur residents has been symbiotic. The Ghazipur residents required assistance from AIKMM to register their joint demonstration with police because they lacked knowledge regarding street politics. Negotiations with police surrounding the registration of the demonstrations was handled by AIKMM, and initially it appeared as if permission would not be granted. In response AIKMM members considered escalating the situation by blocking roads, but Ghazipur residents refused to participate in direct action that was not sanctioned by authorities. Permission to hold a demonstration was finally obtained and the presence of Ghazipur residents lent it legitimacy in the eyes of authorities whose patience with wastepickers is thin because they are unable to make lawful claims to waste. Thus, there are clear reasons why wastepickers and residents aligned, the question that remains surrounds the durability of this alliance and whether it represents a newfound willingness among both groups to combine demands regarding environment and livelihoods. They envision different situated ecologies, so the limits to their cooperation will likely become apparent if the issue of waste-to-energy plants is settled by India's judiciary. For wastepickers the struggle against the reconfiguration of Delhi's SWM system is over their means of subsistence. Just as many farmers and small-scale producers of non-agricultural products in rural areas depend on ecosystems for their livelihoods (what Gadgil and Guha [1995] call "ecosystem people"), wastepickers' livelihoods are dependent on a metabolic configuration characterized by a high volume of accessible recyclable material. This urban metabolism emerged after India's economic reforms in the early 1990s, which, combined with a certain degree of political decentralization, empowered urban middle classes who increasingly demand government officials enforce environmental laws and reduce pollution (ie so-called "bourgeois environmentalism"; see Baviskar 2003). While their immediate motivation is to reduce their exposure to environmental hazards, they also embrace the creation of urban nature, access to which is restricted and serves as a status symbol and evidence of membership in the middle class. Thus, while wastepickers' main objective is to configure Delhi's metabolism in such a way that they maintain access to waste, middle class residents envision a metabolic configuration that produces a situated political ecology that insulates them from waste and enables a desired lifestyle.

These diverse objectives have recently been incorporated into Delhi's formal politics. There was a longstanding consensus among India's rival nationwide parties, India National Congress and Bharatiya Janata Party, surrounding the privatization of waste management and incineration. After a prolonged movement the Aam Aadmi Party (AAP), an upstart party headed by anti-corruption social reformer, came to power in citywide elections in 2013.[11] Okhla residents were assured by Delhi's erstwhile Environment Minister Saurabh Bhardwaj that the AAP government

would address their demands and recently the *India Times* reported that Chief Minister Arvind Kejriwal committed to closing the plant (Nandi 2015). The Deputy Chief Minister subsequently inspected both Okhla and Ghazipur facilities, indicating that the joint efforts of wastepickers and residents in Ghazipur ultimately garnered an official response (*The Times of India* 2015).

During the electoral campaign, the AAP released a Manifesto on Sanitation and Waste Management, wherein the *mohalla sabha* (neighborhood assemblies)[12] would be given complete authority and funds for local waste management. If implemented this would provide a formal platform for wastepickers and residents to devise localized solutions to waste management. While it is unclear if AAP has the authority to close the Ghazipur and Okhla plants, *mohalla sabhas* could conceivably ensure that wastepickers retain access to high-calorific recyclable material thereby channeling waste away from waste-to-energy plants. The politics of waste took a further turn in June 2015, when municipal waste workers went on strike for 12 days.[13] As waste piled up in Delhi's streets, political parties sought to lay the blame with their rivals. Thus, the politics of waste have taken center stage in Delhi and although change will likely be incremental, it is significant that the party in power advocates institutionalizing a decentralized waste management system that includes wastepickers and residents.

Conclusion

In this article we have examined the contestation of Delhi's urban metabolism. Like many Indian cities, Delhi faced a looming public health crisis in the 1990s due to the rapid increase of waste that had been expanding for decades. This metabolic configuration required a response from authorities, enabled wastepickers to earn livelihoods and inhibited middle class residents from practicing the lifestyles to which they aspire. Conflicts erupted, however, when municipal authorities opted to embrace waste-to-energy technology. Wastepickers contest the reworking of Delhi's metabolism because it threatens the access to the waste upon which their livelihoods depend, and middle class residents oppose waste-to-energy because of its perceived deleterious impact on air quality and the concomitant health risks. While environmental politics in urban India has hitherto been understood as the preserve of a bourgeoisie intent on imposing revanchist order and disciplining the poor, this case demonstrates that environmental politics can foster unlikely alliances among these groups.

In order to capture the complexity of the politics surrounding waste in Delhi it is necessary to balance critical urban theory with attention to materiality. These approaches can be complementary so instead of an *a priori* allegiance to one of these theoretical traditions, they should be combined according to local circumstances. In our estimation the concept of an urban metabolism—as conceived by ecological economists and industrial ecologists—allows for the incorporation of an awareness of materiality with critical approaches concerned with power relations and political economy. Urban metabolisms are inherently produced through material and political economic processes—there is no "original" or "real" moment in which either materiality or political economy serves as context or structure. While one or the other may drive change in a particular time/place, they are both always already

co-constituted. A sudden change in one or the other can generate feedback that affects the overall metabolism. In the case we presented material flows of waste are subject to conflicting logics and rationalities (see Watson 2003), yet what ultimately develops is a metabolic configuration that consolidates the throughput of waste in a single formal value chain that ends at a waste-to-energy plant and negatively impacts air quality. This has produced a situated political ecology in which the actual places where waste is collected and processed (eg doorsteps, transfer stations and landfills) have become a "commodity frontier". Commodity frontiers have historically been located in hinterlands where the resources upon which cities depend are extracted (Martinez-Alier et al. 2010; Moore 2000), and the emergence of a commodity frontier within Delhi indicates that we can expect the conflicts surrounding waste to increasingly resemble resource conflicts. In this sense waste represents investment opportunities and its "extraction" produces environmental hazards that jeopardize the health of local residents and inhibits the production of desirable situated political ecologies. In this context, groups whose rationalities may indeed be in conflict can occasionally find common cause in their efforts to affect the situated ecology on this commodity frontier. The city is only livable for those who can integrate themselves within these systems in ways that allow them to earn livelihoods and also socially reproduce. As we demonstrated there are innumerable ways in which people can connect with an urban metabolism, for a range of goals and on highly uneven terms. Given the number of actors seeking access and influence, many of whom pursue divergent goals, urban metabolisms are shaping up to be the primary focal point of sociality and contestation in Southern metropolises. The open question remains: who—if anyone—will promote more sustainable situated political ecologies and why? The answer to this question remains elusive, but our understanding of how social, political and economic struggles produce actually existing urban space will be limited if we do not account for the relationship between political economy and materiality.

Acknowledgements

The authors thank all the interviewees and Giorgios Kallis, Isabelle Anguelovski, Joan Martinez-Alier, Giacomo D'Alisa and Deepak Malghan for comments to earlier drafts of the paper. Federico Demaria also acknowledges support from the project CSO2010-21979 on social metabolism and environmental conflicts as well as the European project EJOLT (Environmental Justice Organizations, Liabilities and Trade). Seth Schindler was supported by a travel grant from the Institute of Asian and African Studies at the Humboldt-University of Berlin.

Endnotes

[1] D'Alisa et al. (2012) define metabolic density of waste as the product of the pace of waste disposed per capita and area ([kg/day]/km^2). This indicator is calculated with the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM).
[2] See http://www.safaisena.net/
[3] See http://aikmm.org/
[4] See http://www.safaisena.net/our-activities.htm
[5] See http://aikmm.org/demands-2/
[6] See http://www.toxicswatch.org/

[7] We use the term "middle class" broadly, to refer to Delhi residents who are formally employed in white collar work. This includes people employed in hi-tech sectors but also accountants, journalists, teachers and small business owners.
[8] See http://www.almitrapatel.com/
[9] See https://www.facebook.com/pages/Okhla-Anti-Incinerator-Committee/203624043005125
[10] See http://www.greentribunal.gov.in/index.php
[11] Delhi's AAP Chief Minister resigned in order to contest national elections, and the party formed a majority government after a landslide victory in citywide elections in 2015.
[12] Each ward is divided into 10 *mohallas*, and all residents of a mohalla are members of the *mohalla sabha*. Each *mohalla sabha* meets bi-monthly. The councilor and all local municipal officials are present and people decide how the municipal funds should be used in that *mohalla* (see http://www.lokrajandolan.org/images/mohalla_sabhas_a_how_to_guide.pdf)
[13] See http://www.ndtv.com/cheat-sheet/money-for-mongolia-not-for-mongolpuri-aaps-dig-at-pm-narendra-over-delhi-garbage-crisis-771037

References

Agarwal A, Singhmar A, Kulshrestha M and Mittal A K (2005) Municipal solid waste recycling and associated markets in Delhi, India. *Resources, Conservation and Recycling* 44(1):73–90

AIKMM (2015) *Rights for Waste Workers as Service Providers: A Comprehensive Valuation of Delhi's Informal Recycling Sector*. Delhi: All India Kabadi Mazdoor Mahansangh

Anguelovski I and Martinez-Alier J (2014) *The environmentalism of the poor* revisited: Territory and place in disconnected glocal struggles. *Ecological Economics* 102:167–176

Bank of America Merrill Lynch (2013) *No Time to Waste: Global Waste Primer*. New York: Bank of America Merrill Lynch. http://www.longfinance.net/images/reports/pdf/baml_waste_2013.pdf (last accessed 13 June 2014)

Baviskar A (2003) Between violence and desire: Space, power, and identity in the making of metropolitan Delhi. *International Social Science Journal* 55(175):89–98

Benjamin S (2008) Occupancy urbanism: Radicalizing politics and economy beyond policy and programs. *International Journal of Urban and Regional Research* 32(3):719–729

Bennett J (2010) *Vibrant Matter: A Political Ecology of Things*. Durham: Duke University Press

Bhan G (2009) "This is no longer the city I once knew": Evictions, the urban poor, and the right to the city in millennial Delhi. *Environment and Urbanization* 21(1):127–142

Castan Broto V, Allen A and Rapoport E (2012) Interdisciplinary perspectives on urban metabolism. *Journal of Industrial Ecology* 16(6):851–861

Chatterjee P (2011) *Lineages of Political Society: Studies in Postcolonial Democracy*. Ranikhet: Permanent Black

Chaturvedi B and Gidwani V (2011) The right to waste: Informal sector recyclers and struggles for social justice in post-reform urban India. In Ahmed W, Kundu A and Peet R (eds) *India's New Economic Policy: A Critical Analysis* (pp 125–153). London: Routledge

Chaturvedi B, Khan I and Sen P (2012) *Give Back Our Waste: What the Okhla Waste-to-Energy Plant Has Done to Local Wastepickers*. Delhi: Chintan. http://www.chintan-india.org/documents/research_and_reports/chintan-report-give-back-our-waste.pdf (last accessed 5 May 2014)

CPCB (2006) *Assessment of Status of Municipal Solid Waste Management in Metro Cities and State Capitals*. Delhi: Central Pollution Control Board

D'Alisa G, Di Nola M F and Giampietro M (2012) A multi-scale analysis of urban waste metabolism: Density of waste disposed in Campania. *Journal of Cleaner Production* 35:59–70

Daniels P L and Moore S (2001) Approaches for quantifying the metabolism of physical economies, Part I: Methodological overview. *Journal of Industrial Ecology* 5(4):69–93

Datta A (2013) *Illegal City: Space, Law, and Gender in a Delhi Squatter Settlement*. Farnham: Ashgate

Decker E H, Elliott S, Smith F A, Blake D R and Rowland F S (2000) Energy and material flow through the urban ecosystem. *Annual Review of Energy and the Environment* 25:685–740

Derickson K D (2014) Urban geography I: Locating urban theory in the "urban age". *Progress in Human Geography* DOI:10.1177/0309132514560961

Doshi S (2013) The politics of the evicted: Redevelopment, subjectivity, and difference in Mumbai's slum frontier. *Antipode* 45(4):844–865

Dupont V D N (2010) The dream of Delhi as a global city. *International Journal of Urban and Regional Research* 35(3):533–554

Ernstson H (2012) "Re-Translating Nature in Post-Apartheid Cape Town: The Material Semiotics of People and Plants at Bottom Road." Actor-Network Theory for Development Working Paper Series, Paper No. 4, Centre for Development Informatics, University of Manchester. http://www.seed.manchester.ac.uk/medialibrary/IDPM/working_papers/cdi_ant4d/ANT4DWorkingPaper4Ernstson.pdf (last accessed 7 August 2015)

Farias I and Bender T (eds) (2010) *Urban Assemblages: How Actor-Network Theory Changes Urban Studies*. New York: Routledge

Fischer-Kowalski M (1998) Society's metabolism: The intellectual history of Material Flow Analysis, Part I: 1860–1970. *Industrial Ecology* 2(1):61–78

Fischer-Kowalski M, Krausmann F, Giljum S, Lutter S, Mayer A, Bringezu S, Moriguchi Y, Schütz H, Schandl H and Weisz H (2011) Methodology and indicators of economy-wide material flow accounting. *Journal of Industrial Ecology* 15(6):855–876

Gadgil M and Guha R (1995) *Ecology and Equity*. London: Routledge

Gandy M (2002) *Concrete and Clay: Reworking Nature in New York City*. Cambridge: MIT Press

Geddes P (1885) *An Analysis of the Principles of Economics*. London: Williams and Northgate

Ghazipur Anti-Incinerator Committee (2012) "Residents and Wastepickers Protest Against Waste-to-Energy Incinerator in Ghazipur." Press release, Delhi, 24 March

Ghertner A (2011) Gentrifying the state, gentrifying participation: Elite governance programs in Delhi. *International Journal of Urban and Regional Research* 35(3):504–532

Giampietro M, Mayumi K and Sorma A H (2012) *The Metabolic Pattern of Society*. New York: Routledge

Gidwani V (2013) Value struggles: Waste work and urban ecology in Delhi. In Rademacher A and Sivaramakrishnan K C (eds) *Ecologies of Urbanism in India: Metropolitan Civility and Sustainability* (pp 169–200). Hong Kong: Hong Kong University Press

Gidwani V and Reddy R N (2011) The afterlives of "waste": Notes from India for a minor history of capitalist surplus. *Antipode* 43(5):1625–1658

Gill K (2010) *Of Poverty and Plastic*. New Delhi: Oxford University Press

Goldman M (2011) Speculative urbanism and the making of the next world city. *International Journal of Urban and Regional Research* 35(3):555–581

Harris A (2013) Assembling global Mumbai through transport infrastructure. *City* 17(3): 343–360

Hayami Y, Dikshit A K and Mishra S N (2006) Waste pickers and collectors in Delhi: Poverty and environment in an urban informal sector. *Journal of Development Studies* 41(1):42–69

Heynen N C (2014) Urban political ecology I: The urban century. *Progress in Human Geography* 38(4):598–604

Heynen N C, Kaika M and Swyngedouw E (eds) (2006) *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. London: Routledge

Holifield R (2009) Actor-network theory as a critical approach to environmental justice: A case against synthesis with urban political ecology. *Antipode* 41(4):637–658

Kaika M (2006) Dams as symbols of modernization: The urbanization of nature between geographical imagination and materiality. *Annals of the Association of American Geographers* 96(2):276–301

Kaika M and Swyngedouw E (2000) Fetishizing the modern city: The phantasmagoria of urban technological networks. *International Journal of Urban and Regional Research* 24(1): 120–138

Keil R and Graham J (1998) Reasserting nature: Constructing urban environments after Fordism. In Braun B and Castree N (eds) *Remaking Reality: Nature at the Millennium* (pp 98–124). London: Routledge

Kennedy C, Cuddihy J and Engel-Yan J (2007) The changing metabolism of cities. *Journal of Industrial Ecology* 11(2):43–59

Krishna G (2013) Chinese incinerator is poisoning food chain of residents and birds of Delhi's Okhla. *Toxics Watch Alliance* 13 November. http://www.toxicswatch.org/2013/11/chinese-incinerator-is-poisoning-food.html (last accessed 21 November 2014)
Lancione M (2013) Homeless people and the city of abstract machines: Assemblage thinking and the performative approach to homelessness. *Area* 45(3):358–364
Lawhon M (2013) Flows, friction, and the sociomaterial metabolization of alcohol. *Antipode* 45(3):681–701
Lawhon M, Ernstson H and Silver J (2014) Provincializing urban political ecology: Towards a situated UPE through African urbanism. *Antipode* 46(2):497–516
Makri A and Devraj R (2015) Delhi's waste site story. *SciDev.Net* 19 November. http://www.scidev.net/global/cities/multimedia/delhi-waste-site-photo-essay.html (last accessed 5 July 2015)
Martinez-Alier J (1987) *Ecological Economics: Energy, Environment, and Society*. Oxford: Blackwell
Martinez-Alier J (2002) *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Cheltenham: Edward Elgar
Martinez-Alier J, Kallis G, Veuthey S, Walter M and Temper L (2010) Social metabolism, ecological distribution conflicts, and valuation languages. *Ecological Economics* 70(2): 153–158
Martinez-Alier J, Temper L and Demaria F (2014) Social metabolism and environmental conflicts in India. *Indialogs* 1:51–83
Mawdsley E (2004) India's middle classes and the environment. *Development and Change* 35(1):79–103
MCD (2012) *Report on Delhi's MSW Management*. Delhi: Municipal Corporation of Delhi Department of Environment Management Services
McFarlane C (2011a) On context: Assemblage, political economy, and structure. *City* 15(3/4):375–388
McFarlane C (2011b) Assemblage and critical urbanism. *City* 15(2):204–224
McFarlane C (2013) Metabolic inequalities in Mumbai. Beyond telescopic urbanism. *City* 17(4):498–503
Meehan K M (2014) Tool-power: Water infrastructure as wellsprings of state power. *Geoforum* 57:215–224
Mitchell T (2011) *Carbon Democracy: Political Power in the Age of Oil*. New York: Verso
Moore J W (2000) Sugar and the expansion of the early modern world-economy: Commodity frontiers, ecological transformation, and industrialization. *Review: A Journal of the Fernand Braudel Center* 23:409–433
Mumford W (1938) *The Culture of Cities*. New York: Harvest
Nandi J (2015) Delhi CM Kejriwal promises to shut Okhla waste plant. *The Times of India* 27 February. http://timesofindia.indiatimes.com/city/delhi/Delhi-CM-Kejriwal-promises-to-shut-Okhla-waste-plant/articleshow/46389323.cms (last accessed on 6 July 2015)
NEERI (National Environmental Engineering Research Institute) (2005) *Assessment of Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities and Class II Towns*. Delhi: Central Pollution Control Board
Negi R (2010) Neoliberalism, environmentalism, and urban politics in Delhi. In Ahmed W, Kundu A and Peet R (eds) *New Economic Policy in India: A Critical Analysis* (pp 179–198). London: Routledge
Newell J P and Cousins J J (2014) The boundaries of urban metabolism: Towards a political-industrial ecology. *Progress in Human Geography* DOI:10.1177/0309132514558442
Pieterse E (2008) *City Futures: Confronting the Crisis of Urban Development*. London: Zed
Rademacher A and Sivaramakrishnan K C (eds) (2013) *Ecologies of Urbanism in India: Metropolitan Civility and Sustainability*. Hong Kong: Hong Kong University Press
Ranganathan M (2015) Storm drains as assemblages: the political ecology of flood risk in post-colonial Bangalore. *Antipode* DOI:10.1111/anti.12149
Rediff News (2012) Toxic ash engulfs south Delhi's Okhla neighbourhood. 27 December. http://www.rediff.com/news/report/photo-toxic-ash-engulfs-south-delhis-okhla-neighbourhood/20121227.htm (last accessed 21 November 2014)

Schindler S (2014a) The making of "world-class" Delhi: Relations between street hawkers and the new middle class. *Antipode* 46(2):557–573
Schindler S (2014b) A New Delhi everyday: Multiplicities of governance regimes in a transforming metropolis. *Urban Geography* 35(3):402–419
Schindler S, Demaria F and Pandit S B (2012) Delhi's waste conflict. *Economic and Political Weekly* 47(42):18–21
Searle L G (2014) Conflict and commensuration: Contested market making in India's private real Estate development sector. *International Journal of Urban and Regional Research* 38(1): 60–78
Sethi A (2012) Incinerator gases choking Okhla. *Deccan Herald* 12 July. http://www.deccanherald.com/content/263944/incinerator-gases-choking-okhla.html (last accessed 12 January 2014)
Shatkin G (ed) (2014) *Contesting the Indian City: Global Visions and the Politics of the Local*. Malden: John Wiley & Sons
Shaw G R and Meehan K (2013) Force-full: Power, politics, and object-oriented philosophy. *Area* 45(2):216–222
Silver J (2014) Incremental infrastructures: Material improvisation and social collaboration across post-colonial Accra. *Urban Geography* 35(6):788–804
Swyngedouw E (1996) The city as hybrid: On nature, society, and cyborg urbanization. *Capitalism Nature Socialism* 7(2):65–80
Swyngedouw E and Heynen N C (2003) Urban political ecology, justice, and the politics of scale. *Antipode* 35(5):898–918
Talyan V, Dahiya R P and Sreekrishnan T R (2008) State of municipal solid waste management in Delhi, the capital of India. *Waste Management* 28(7):1276–1287
The Hindu (2011) Jindal's Okhla waste-to-energy plant broke law, says Jairam. 1 April. http://www.thehindu.com/todays-paper/tp-national/tp-newdelhi/jindals-okhla-wastetoenergy-plant-broke-law-says-jairam/article1589906.ece (last accessed 5 July 2015)
The Hindu (2012) Protest against waste-to-energy incinerator. 25 March. http://www.thehindu.com/todays-paper/tp-national/tp-newdelhi/protest-against-wastetoenergy-incinerator/article3221985.ece (last accessed 21 November 2014)
The Times of India (2015) Sisodia gets feel of Okhla plant's smoke and ash. 23 May. http://timesofindia.indiatimes.com/city/delhi/Sisodia-gets-feel-of-Okhla-plants-smoke-and-ash/articleshow/47392336.cms (last accessed 21 November 2014)
UNEP (2013) *City-Level Decoupling: Urban Resource Flows and the Governance of Infrastructure Transitions*. Nairobi: United Nations Environment Programme. http://www.unep.org/resourcepanel/Publications/City-Leveldecoupling/tabid/106135/Default.aspx (last accessed 2 November 2013)
Watson V (2003) Conflicting rationalities: Implications for planning theory and ethics. *Planning Theory and Practice* 4(4):395–407
While A, Jonas A E G and Gibbs D (2010) From sustainable development to carbon control: Eco-state restructuring and the politics of urban and regional development. *Transactions of the Institute of British Geographers* 35(1):76–93
WIEGO (2013) *Waste Pickers: The Right to Be Recognized as Workers*. Cambridge: Women in Informal Employment: Globalizing and Organizing. http://wiego.org/resources/waste-pickers-right-be-recognized-workers (last accessed 7 August 2015)
Wilson D C, Velis C and Cheeseman C (2006) Role of informal sector recycling in waste management in developing countries. *Habitat International* 30(4):797–808
Wolman A (1965) The metabolism of cities. *Scientific American* 213(3):179–190
World Bank (1999) *Municipal Solid Waste Incineration: World Bank Technical Guidance Report*. Washington, DC: World Bank. http://www.worldbank.org/urban/solid_wm/erm/CWG%20folder/Waste%20Incineration.pdf (last accessed 19 November 2014)