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A political–industrial ecology of water supply infrastructure for Los Angeles

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ABSTRACT

This paper develops a political–industrial ecology approach to explore the urban water metabolism of Los Angeles, which sprawls for thousands of miles across the American West. Conventional approaches to quantify urban carbon footprints rely on global, national, or regional averages and focus narrowly on improving the efficiency of flows of resources moving into and out of the city. These approaches tend to "black box" the methodologies that guide the carbon emissions calculus and the social, political, ecological, and economic processes that perpetually reshape nature–society metabolisms. To more fully delineate the water supply metabolism of Los Angeles, this paper combines theory and method from urban political ecology and industrial ecology. Specifically, we infuse spatiality into the traditional life-cycle assessment (LCA) approach by coupling it with GIS. By illustrating how decisions about system boundaries, emissions factors, and other building blocks fundamentally shape the end result, this intervention at once destabilizes and advances the LCA enterprise. Then, using interviews and historical analysis, we provide a critical analysis of how LA's various water supply infrastructures came to be and illustrate how a sustainable transition based on a narrow carbon calculus is problematized by historical circumstances and strategic (and often conflicting) new paradigms to secure water resources. The political–industrial ecology approach offers valuable insights into the spatiality of material metabolisms and the socio-political processes (re)shaping the relations between nature and society.

1. Introduction

> "*Owens Lake, the terminus of the [Owens R]iver, sat at an elevation of about four thousand feet. Los Angeles was a few feet above sea level. The water, carried in pressure aqueducts and siphons, could arrive under its own power. Not one watt of pumping energy would be required. The only drawback was that the city might have to take the water by theft*".
>
> [Reisner, 1986, 61]

While theft may no longer be an option in Los Angeles's quest to secure and increase its water supply, Reisner draws attention to two important aspects that this paper seeks to address. The first aspect is the embodied energy and emissions of Los Angeles's water supply metabolism. Los Angeles, like other global cities, has established programs for reducing GHG emissions while making overt references to reduce their reliance on distant and uncertain resource flows and infrastructures (Bulkeley and Betsill, 2013; Bulkeley, 2010; Rice, 2010). These concerns over "urban ecological security" reflect exposure to regulatory, climatic, and political drivers that influence how the City of Los Angeles is managing its water supply through the development of local and decentralized systems to build greater self-sufficiency and reliance while simultaneously reducing GHG emissions (Hodson and Marvin, 2009; Hughes et al., 2013; LADWP, 2010a). Indeed, climate models indicate that snowpack in the Sierras may decrease from its mid-20th century average by 25–40% by 2050 reducing the water available via the Los Angeles Aqueduct (CDWR, 2008). This, coupled with ongoing drought conditions, is driving policy makers and planners to rework the socio-technical systems delivering water to the region.

Faced with simultaneous pressure to reduce GHG emissions while securing a stable supply, cities like Los Angeles have begun to assess the nexus between water and energy consumption by measuring the carbon footprint of their water systems. The methodology guiding these analyses is life-cycle assessment (LCA), an important tool in industrial ecology that quantifies environmental impacts of products and processes during each phase of its "life"—from material extraction to disposal (Freidberg, 2013; Graedel and Allenby, 2003; Newell and Vos, 2011). In theory, once the carbon

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emissions burden—or the relative impact or footprint of the respective life phases, process, or product—is known, strategies to facilitate low-carbon and sustainability transitions can be made (Bulkeley, 2010; Bulkeley et al., 2013; Hodson and Marvin, 2010; Smith et al., 2005). This calculative process of urban environmental governance centered on "carbon control" often drives interventions to re-work urban socio-technical systems (Bulkeley and Castán Broto, 2012; Jonas et al., 2011; While et al., 2010). To increase local supplies, LADWP is focusing on projects that increase recycled water, expand water conservation, enhance stormwater capture, and establish green building initiatives (LADWP, 2010a, 2010b; Solorio, 2012; Villaraigosa, 2008). The objective is to make water demands more efficient while developing supply sources that are less vulnerable to climate change (LADWP, 2010a; Villaraigosa, 2008). But this (re)development of socio-technical systems to re-work Los Angeles's water metabolism may not always align with the desired emissions targets or foster a social and environmentally just system.

The second aspect this paper addresses is the historical and political processes shaping the water supply metabolism of Los Angeles, a metabolism that extends to the watersheds of the Sacramento and Colorado Rivers and to the Owens Valley and High Sierras (Fig. 1). Building the 233-mile Los Angeles Aqueduct (LAA), for example, required the construction of 120 miles of railroad track, 500 miles of roads and trails, 240 miles of telephone line, and 170 miles of transmission line (Reisner, 1986). The relationships and interdependencies among and between these infrastructures represent a unique political ecology, one that materialized out of the political and economic support for William Mulholland's vision to bring the waters of the Owens Valley to Los Angeles. The social–ecological transformation of the Valley that followed was the result of failed protests, legal challenges and national laws, rules, negotiations, and agreements between Valley residents and the City of Los Angeles. With current concerns over carbon emissions, however, the low emissions burden of water conveyed via the LAA brings into contrast the contradictions between reducing emissions and the internal properties, politics, and contestations that are hidden or "black boxed" (Latour, 1987) when focusing only on the input–output analysis of reducing GHG emissions or supplying a city with water.

We investigate these aspects through a framework that utilizes industrial ecology (IE) and urban political ecology (UPE) to examine the energy and material flows of Los Angeles's urban water metabolism. The approach integrates spatiality and critical theory from geography to develop a political–industrial ecology approach to the study of urban metabolisms. This is done by building a spatially-explicit LCA to model the embodied energy and emissions of Los Angeles's water supply sources. The analysis is scaled down to the utility to provide a finer grained analysis of the city's water supply metabolism and as a means to advance LCA by integrating spatial differentiation into the modeling process. While the GIS–LCA coupling provides a well-suited approach to explore the spatialized emissions and some environmental impact questions, it is limited in its ability to consider the socio-political dimensions of GHG emissions. To address this limitation, we link the LCA–GIS model with insights from political ecology to explore the planning

Fig. 1. Map of water supply sources for the City of Los Angeles.