Locked-in post-socialism: rolling path dependencies in Liberec’s district heating system

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ABSTRACT
This paper uses the experience of post-socialist district heating reforms to tell a broader story about the continued and shared challenges that central and eastern European cities face as they grapple with the legacies of the recent and more distant past. We argue that the restructuring of this infrastructural domain has been contingent upon geographically embedded trajectories stemming from previous historical periods, while leading to the creation of new socio-technical lock-ins. The paper thus develops the notion of “rolling path-dependencies” in order to explore how post-socialist developments both overcome and supplant previous trajectories of transformation. It focuses on the northern Czech town of Liberec – a place that is known for having some of the highest heating prices in the country – to elucidate how a socially, economically, and environmentally detrimental lock-in has come into existence as a result of ill-conceived policies of marketization, municipalization, and privatization. Using evidence from official documents and interviews with policy-makers, we demonstrate how the infrastructural legacies of post-socialism both persist and are being reproduced at the urban scale even within “advanced” reforming states like Czechia.

Introduction
Liberec is a medium-sized city and regional administrative center nested amidst the mountains that line Czechia’s northern borders with Poland and Germany. It has generally remained outside the attention of mainstream academic research on economic and political change within and beyond the region. Yet this city with a population of just over 100,000 people recently entered the national limelight as a result of news reports that local citizens were paying astronomically high prices
for their district heating (DH) supply (Pšeničková 2015). Not only did heating tariffs rise well beyond affordable levels, but households were locked into a system that prevented them from switching to a different source of energy supply. In addition, there was evidence to suggest that the local authority was indirectly supporting the privately owned DH company via a complex web of ownership interests and policy measures.

As it turns out, the Liberec case is not isolated in the context of the post-socialist countries of Central and Eastern Europe (CEE) and the Former Soviet Union (FSU). In fact, a number of cities and countries in the region have struggled with the legacies of centralized heating supply systems – commonly known as district heating systems (Poputoaia and Bouzarovski 2010) – inherited from their respective centrally planned economies. This large-scale form of energy provision was emblematic of the political ideologies and urban development policies that underpinned state socialism. The system entailed the delivery of hot steam or water to households and companies via large and centralized networks of pipes and pumping stations. The water itself was heated in fossil-fuel burning plants (primarily coal, heavy fuel oil, and sometimes gas) that also often produced electricity. Under the unfolding crisis of the socialist system, the plants and networks themselves became poorly maintained, with much energy being lost between the sites of production and consumption (Bouzarovski 2009; Rezessy et al. 2006).

DH systems were intimately tied to economic, social, and spatial planning practices and policies under socialism. These networks accompanied mass production and supported daily life and mass consumption of heat in standardized housing. They were also dependent on the promotion and maintenance of particular types of urban forms. The upkeep of such sizeable networks became costly and complex under the market conditions that evolved after the fall of communism. With increasing numbers of consumers switching to other energy carriers – leading to falling revenues and a subsequent need for additional price increases – utilities resorted to punitive measures to prevent further disconnection. Evidence of consumers being “trapped in the heat” has emerged in several CEE countries (Poputoaia and Bouzarovski 2010; Tirado Herrero and Ürge-Vorsatz 2012).

In this paper, we use the case of DH and the experience of Liberec more specifically as a starting point for making a broader argument about the continued importance of integrated perspectives on past and present urban transitions and transformations in CEE and the FSU. Drawing upon the multiple transformations model by Sýkora and Bouzarovski (2012), we argue that the need for a holistic view on post-socialist systemic change still holds relevance for developments in the region and beyond, because micro- and meso-scale transformations in the domains of social practice, organizational change, and the evolution of urban and regional landscapes are ongoing. These claims are developed with reference to the specific infrastructural character of DH, which embodies the institutional and socio-technical inertia of past systems, being nested in past and present urban formations and challenged by recent impacts of free market conditions. Thus, DH
can tell us a broader story about the continued and shared challenges that CEE and the FSU face as they continue to grapple with the legacies of communist central planning – even in the case of countries like Czechia that are now well integrated into the sphere of Western capitalism.

In advancing these claims, we do not wish to negate or diminish growing calls for the inclusion of the post-socialist heuristic into a global sensibility of urban change, potentially entering into a dialog with post-colonial frameworks (Chari and Verdery 2009). Nor do we intend to retreat to the presumably safer space of area studies, which, as some have argued, holds the risk of driving the study of CEE and FSU cities into a corner that underplays and trivializes the wider political–economic relations that underpin changes in this part of the world (Sjöberg 2014). Rather, the contribution that follows highlights the need for focusing on the systemic nature of socio-spatial processes that have been unfolding in this part of the world over the past 25 years. There is an emphasis on understanding how the period of post-socialist restructuring has been contingent upon geographically embedded path-dependencies stemming from previous historical periods, while leading to the creation of new socio-material lock-ins. We develop the notion of “rolling path-dependencies,” which signifies that new paths arise during periods of systemic change by both overcoming and supplanting previous trajectories of transformation (Horak 2007; Sýkora 2008). While challenging mainstream neoliberal understandings of transition (Åslund 1992), this perspective also holds relevance for the understanding of similar deep-seated processes of socio-spatial restructuring in other parts of the world.

**Theorizing systemic change: legacies and path dependencies in post-socialism and beyond**

The last 15 years have seen the publication of a significant body of academic and policy contributions aimed at unraveling the relationship between urban transformations in the post-socialist space, on the one hand, and wider political and economic developments in CEE and FSU, on the other. In contrast with the relatively prescriptive one-dimensional understanding of transition that was advanced by neoliberal economists in the early 1990s (Åslund 1992; Sachs 1990), it has come to be acknowledged that the movement to a market-based economy requires complex and lengthy reconfigurations in a multiplicity of spheres. What is more, the political and institutional application of normative reform frameworks has been preceded, supplemented, and followed by a wider range of more subtle and less visible shifts in the governance and conduct of everyday life. These involve the establishment of new regulatory principles and informal practices that are simultaneously shaped by and shape broader neoliberal agendas (Stenning et al. 2010). Thus, post-socialist change can be seen as the emergence of a specific array of interconnected social dynamics with indeterminate outcomes. It is enacted via “multiple transformations,” whose expressions...
Post-socialist transition dynamics are geographically delimited: they take place in countries that have experienced a large-scale movement away from the centrally planned economy and one-party system (Smith and Swain 2010). This suggests that a level of commonality exists across the entire CEE and FSU space, and in relation to similar state socialist economies in Asia, Africa, and the Americas. Understanding the intrinsic nature of these shared features has often required focusing onto the geographical specificities of “post-socialist difference” (Sjöberg 2014). However, it has been argued that a spatial emphasis on the defining characteristics of transforming CEE and FSU cities limits the ability of post-socialist urban studies to engage with wider theoretical paradigms while relegating analyses and conceptualizations of systemic change in the region to the domain of area studies (Ferenčuhová 2016; Moore 2001; Tuvikene 2016). While constraints on space do not allow for a wider engagement with such debates within the confines of this contribution, we would emphasize that they have often neglected the temporal dimension of political and material reconfigurations associated with post-socialist urban reconfigurations. The CEE and FSU transformation process can be seen as an amalgamation of critical junctures stemming from the collective and individual decisions taken by institutional and household actors reflecting both socialist legacies and challenges of capitalism. Systemic knowledge that is applicable well beyond the post-socialist context can emerge from a conceptualization of the socio-material nature of reform choices, their relationships with wider political dynamics, and their implications for urban transformations writ large.

The significant body of literature on path-dependencies and “hysteresis effects” in CEE and the FSU (Hausner, Jessop, and Nielsen 1995; Sýkora 2008; Yavlinsky and Braguinsky 1994) made numerous inroads into the relationship between surviving vestiges of the state-socialist system – be they social, economic, or spatial – on the one hand, and reform trajectories followed by countries in the region, on the other (Golubchikov, Badyina, and Makhrova 2014). This work has primarily seen path-dependencies in the context of past developments, in addition to highlighting their economic sub-optimality from the perspective of neoliberal approaches. There has been a strong focus on the manner in which historically formed forces create economic and material rigidities that limit the number of options available to agents. Such arguments have often been developed with reference to the more widely observed “tendency for the geographical structure of the economy to exhibit historical ‘quasi-fixity’” (Martin and Sunley 2006, 414), thus shedding light on the processes whereby “an economic landscape has come to be what it is.” Indeed, the wider body of scholarship on the subject has often argued that path dependency is a fundamental feature of territorial evolution (Boschma 2015). This is because path-dependencies are often predicated upon lock-ins, whose inflexibility can bring about stable conditions and benefits in some contexts, while preventing the emergence of new forms of internal development and flexible
adaptation in others (Underthun et al. 2014). According to Setterfield (1996), lock-ins arise when sequential patterns of activity form a “groove” that render the system “over-committed” to particular technologies, industries, or institutional regimes.

A distinct strand of research on path-dependencies has explored the process of “path-creation,” where the emphasis is on “the time that events occurred even if one were looking at data gathered in the past” (Garud, Kumaraswamy, and Karnøe 2010, 770). Authors working in this vein have underlined the complex agencies involved in the establishment of new development paths, even if some of the traditional components – initial conditions, contingencies, self-reinforcing mechanisms, and lock-in – still exist in their conceptual vocabulary (2010). But a large part of path creation thinking has to date remained highly normative, being interested primarily in the measures and strategies that need to be implemented in a given geographical or social context in order to achieve a previously defined outcome (Simmie 2012). The literature on the subject has paid little attention to the spontaneous emergence of new path-dependencies in periods of change. Such lacunae also extend to the CEE and FSU space, where the recognition that post-socialist transformations are not only path-dependent but also path-shaping (Pickles and Smith 1998) has yet to be translated into comprehensive theorizations that would apply to the rise of new paths after 1990 (but see Horak 2007; Sýkora 2008). But some scholars have suggested that the sequencing of restructuring decisions and practices in post-socialism plays a key role in determining policy trajectories. This line of thinking is epitomized in Dahrendorf’s (1990) “clocks” metaphor, which recognizes that diverse transformations of institutions, politics, everyday routines, and spatial formations unfold at a different pace, with some processes requiring changes in others before they can commence (Sýkora and Bouzarovski 2012). It follows that new path dependencies can emerge at critical junctures during such multiple transformations, when actors make contingent choices that define and consolidate a specific trajectory of development (Sýkora 2008).

Nevertheless, new development trajectories are not formed in a vacuum. Gentile, Tammaru, and van Kempen (2012) argue that understanding socialist legacies is essential to grasp the nature of the relationship between social and spatial change. Golubchikov, Badyina, and Makhrova (2014) point to the mutual embeddedness of socialist legacies and neoliberal practices, which “subsume legacy, recode its meaning, and recast the formerly egalitarian spaces as an uneven spatial order” (2014, 617). Hence, post-socialist transition entails not only transformations aimed at the dismantling of established legacies and the formation of new paths, but also a more complex situation of living with the aftermath of socialism under an emergent capitalist regime. This is especially true in the case of large-scale materially based infrastructures embedded in urban landscapes, including public transport systems and mass-produced housing (Chelcea and Pulay 2015; Ürge-Vorsatz, Miladinova, and Paizs 2006). Even if they were originally constructed to achieve a higher quality of living and a more egalitarian society, these socio-technical systems have become alienated from their original purpose.
The logic of neoliberal capitalism has driven their utilization for profit-making purposes, bringing forth new socio-spatial inequalities (Chester 2013; Guogis, Šilinskytė, and Bileišis 2014; Pye et al. 2015).

**Methods and paper structure**

The decision to focus our study on the case of Liberec was made on the basis of prior knowledge, as well as the city’s prominence in Czech public discourses regarding DH restructuring. However, this exploration was embedded in a wider documentary review of relevant strategic papers and policies at the national and regional scales. We thus juxtaposed evidence from multiple sources. The legal, regulatory, and policy background was studied by surveying the secondary literature on energy supply and heating, as well as on more general urban, housing, and planning developments. Official information about the performance of the town’s heating network was acquired from the annual reports of the Liberec DH joint-stock company (“Liberecká teplárenská”) between 2001 and 2015, as well as the Termizo waste incineration joint-stock company for 2003–2015. Information about day-to-day policy practices, relations, positions, and interpretations was obtained from interviews with eight local and national decision-makers, public policy advocates, and company representatives that took place in 2015 and were supplemented by further two inquiries at Liberecká teplárenská in 2016. The interviews lasted between one and two hours, were undertaken in Czech, and took place in the participants’ own professional premises or other public spaces. They were transcribed, translated, and analyzed interpretively, in line with the conceptual apparatus provided by lock-in and path-dependency frameworks. Interview questions focused on how relevant policy-makers understood and interpreted the socioeconomic and institutional contexts of energy, housing, and urban transformations in their everyday practice, as well as their interactions with other bodies of the state administration in addition to citizens, private companies, experts, and non-governmental organizations.

In the sections that follow, we first develop a framework for a conceptual understanding of how new lock-in situations emerge by discussing the nature of DH networks, their embeddedness in the socialist regime, and the role of the newly established capitalist system in driving them. We then turn to privatization dynamics and the overall marketization of society in the context of DH reforms. Moving to the case of Liberec, the paper subsequently recounts the story of local government responses to the structural conditions that became apparent at moments when decisions had to be taken about future developments in the heat sector. Specifically, we focus on the relationship between systemic factors such as the Liberec DH company’s rapidly declining customer base and the overall decrease in urban heat consumption, on the one hand, and increasing operating costs, on the other. This vicious circle of mutually reinforcing effects, we argue, has undermined the viability of DH systems in Liberec while trapping parts of the population and
some urban neighborhoods into high costs without an exit strategy. We subsequently identify the existence of multiple and mutually related lock-in situations concerning (1) the role of historical legacies emerging at the juxtaposition of radically differing societal regimes; (2) the technical and economic underpinnings of DH operation and capacity under changing external conditions; (3) the policy challenges faced by local government amidst an organizationally complex and politically contentious decision-making landscape; and (4) the socio-spatial injustices encountered by people who live in the neighborhoods served by DH.

The legacy of district heating in Czechia

As was noted above, DH systems physically consist of fossil fuel-powered co-generation plants – or in some cases, heat-only boiler stations – connected to distribution systems involving the transport of hot water or steam via insulated pipes (Rezaie and Rosen 2012). There are also local pumping stations and internal heating networks within buildings. Czechia’s first centralized supply systems of the kind were established in the 1930s and 1940s to serve the country’s then-booming industrial sector, as well as working-class housing in cities. Using modern technologies and coal for the production of both electricity and steam heating, they symbolized the modern “technological sublime” (Nye 1996) of energy and heating delivery in urban agglomerations, concentrating energy generators and end-consumers in close-knit infrastructural reticulations (Kaufmann 2007).

DH systems rapidly expanded during the first decades of communist rule, driven by a rise in energy demand generated by the expansion of heavy industry, as well as newly built residential estates in urban areas. Their built-in collectivism combined with the centrally planned economy’s focus on the construction of large plants and systems to lead to the establishment of expansive systems for the centralized provision of heat. Under socialism, DH provided the only means of providing hot water and heating for large parts of the population: the systems were literally and figuratively tied to large-scale electric power plants built at the urban fringe, from where hot water was transported to both industrial zones and residential neighborhoods. In the 1970s and 1980s, the construction of new housing estates was accompanied by the development of locally based heat networks that used less polluting sources of energy, principally heavy fuel oil and gas. However, the technologies that were applied in this context were progressively at odds with global energy efficiency and cost savings trends, principally due to a series of economic recessions and the increasing shortage of investment finance. DH currently supplies almost 1.6 million dwellings (38% of the housing stock) in Czechia, principally in larger cities (CSO 2011).

One of the reasons for the expansion of DH in Czechia lies in the close alignment between the infrastructural characteristics of the system – massive, shared, top-down, centralized, egalitarian – and the political ideologies of the socialist state. In addition to large housing estates and industrial plants, key DH consumers included
older inner city tenement-style buildings and single-family houses, as well as administrative and service buildings; schools, hospitals, sports halls, entertainment facilities, restaurants, and commerce. The systems were relatively easy to build and maintain throughout due to their alignment with the centrally planned construction of new housing, services, and industries, as well as the spatially concentrated nature of urban development during socialism. Environmental concerns also justified investment in DH, because the networks replaced coal-burning stoves in inner-city areas with a relatively less-polluting and more remote source of energy.

However, the structural weaknesses of DH systems became apparent after the introduction of a market system and decentralized decision-making. The low technical efficiency of plants and distribution networks was incompatible with new environmental criteria, especially in the case of systems based on oil- or gas-burning heat-only boilers. Poor construction standards and the lack of maintenance increased operation costs while leading to high-energy losses in the distribution networks. The system’s blanket coverage of socialist consumers under soft budget constraints (Kornai 1986) – including both subsidized energy prices and the tolerance of poor financial management within companies – was challenged by the economic conditions that characterized liberalized markets, as well as the installation of individual meters. Also, the customer base of DH plants began to shrink due to the emergence of more affordable and convenient heat supply options. This trend was reinforced by the economic collapse of many industrial consumers. Thus, networks built under the centrally planned and organized system of energy production and consumption exhibited “suboptimal” path-dependent features after the political and economic changes in 1989.

Private heat: energy sector reforms at the national scale

Urban heating systems are a highly specific segment of the energy sector in technical and policy terms alike (Bouzarovski 2010; Persson and Werner 2011). While the production and distribution of electricity and gas are regulated at the national scale, DH systems are a secondary and local source of energy – they use externally supplied fuels whose chemical energy is converted into heat, and their outputs are circulated in a geographically restricted area. These characteristics influenced the Czech government’s approach towards the post-socialist regulation of DH.

After the collapse of communism, vertically and horizontally integrated socialist state monopolies in the energy sector – electricity, gas, and heating – were legally and financially unbundled, creating discrete organizational units that could be sold or handed over to private actors. Due to being seen as key strategic assets, electricity and gas networks were not part of the first wave of privatization. Coal mining and gas distribution companies became subject to the process only in the late 1990s and early 2000s. The electricity market was left in the hands of the Czech Power Utility (ČEZ) – a company with dominant state ownership and no plans for privatization. However, most heating plants and distribution networks
were privatized already in the first half of the 1990s. Some systems became joint stock companies with shares that were later sold to private investors. Others were transferred to municipalities, which either sold them off or began operating them via a variety of legal arrangements. In a number of cases, local authorities have established joint ventures with strategic private partners.

The privatization and municipalization of urban heating systems shifted the state’s responsibilities onto private actors and local administrations. This process coincided with the wider movement of property rights and regulatory power towards the municipal level (how this happened in the housing sector is documented in Sýkora 2003), even if many local authorities lacked the strategic, organizational, and technical capacity to manage such complex infrastructural systems. The transfer of ownership to municipalities resulted in different local approaches to the management of newly obtained assets. The entry of private capital provided a quick fix to address this set of emergent, unknown, and unpredictable socioeconomic conditions. Privatization was also supported by neoliberal discourses about the inefficiency of publicly owned operations, as well as the need to repair and reconstruct obsolete infrastructures, while covering high operational costs. Widespread opposition to long-term planning combined with uncritical support for the “free market” to support ad hoc decisions aimed at reaping quick political benefits (Horak 2007) rather than considering deleterious future consequences.

Nevertheless, neoliberal market conditions made it difficult to renovate the technically unwieldy assemblies of power stations, heating plants, and distribution infrastructures. Price liberalization and energy cost increases meant that people and firms alike were affected by increasing utility bills (Buzar 2007). The low-energy efficiency of heating and distribution infrastructures inherited from socialism also led to high final prices. At the same time, the costs of further upgrades and energy efficiency improvements had to be borne by end-use consumers (Bouzarovski 2015; Bouzarovski and Tirado Herrero 2016). All of this happened during a period when new energy providers with alternative offers were entering the market. Disconnections from the DH system led to price increases for the customers who remained part of the network. The vicious circle of disconnections and price increases could only be prevented by the will and resources of municipal or private heat providers.

DH regulation and policy in Liberec

Liberec’s centralized network of heating supply was constructed in the 1970s in order to address industrial and population growth at the time. It unified a set of disparate systems that served housing estates built during the 1960s. A key factor in this regard was provided by the availability of cheap heavy fuel oil from the Soviet Union and the desire to shift away from coal. Even though the system started to provide heat in 1977, it only became functional during the 1980s – thus
supplying housing estates, schools, public service and administration buildings, and industry. Its two boilers eliminated the use of local heating sources in the city – including over 200 burners in industrial plants – thus substantially contributing to decreased air pollution in a city located between mountain ranges. Rising heat demand subsequently led to the construction of a third boiler, as well as the addition of reused industrial boilers. After the fall of communism, the system was incorporated in the North Bohemian Heating Plants holding company, aimed at providing a vehicle for privatization. Soon thereafter, the Liberec network was sold to United Energy, with the local authority maintaining a 30% stake. In 2007, the United Energy portion was sold to MVV Energie CZ, while the municipality kept its share.

Changes in ownership, national regulation, and patterns of local political representation brought about significant shifts in the management and development of the DH system, as well as the socio-technical provision of heat to inhabitants, institutions, and firms. In the 1990s the combination of tightened environmental legislation and growing oil prices led to the retrofitting of the DH plant so as to enable the combined use of gas and heavy heating oil. More importantly, the city government forged a partnership with neighboring municipal administrations (in the form of the “Termizo” company), aimed at constructing and operating a new waste incinerator. In addition to burning refuse for the entire region, it would provide heat for the DH network in Liberec. Even though the incinerator was built between 1996 and 2000 with the aid of government subsidies and a bank loan (see Figure 1),

Figure 1. The district heating plant (left) and incinerator (right) occupy a prominent location in the city center of Liberec. Source: Photo by Stefan Bouzarovski.
further changes in environmental legislation necessitated the addition of costly new technologies. Local government officials were unwilling to finance such outlays and thus increase their indebtedness. Instead, they preferred to use the public budget to fund other large-scale projects, such as a multi-purpose arena. It was thus decided that the new incinerator would be sold to a private investor – the PPF Group. The deal also involved the distribution network, whose ownership was evenly split between the investor and municipality. MVV Energie CZ – the same company that owned the heating plant – bought the incinerator in 2011, with the municipality maintaining minority representation on the governing board of the company. It currently burns about 100,000 tons of waste each year.

Liberec’s municipal authorities are otherwise known for having taken one of the most aggressive approaches in the neoliberal reform process, having privatized much of their housing, land, and other capital assets (Demel and Potuzáková 2012; Langr 2014). While a number of improvements were made to the DH plant in order to increase its efficiency and decrease air pollution emissions, the city-owned distribution network was not targeted at all. Investment in the new incinerator was expected to bring financial profits to its new private owners. With national heat prices being deregulated in 2005, DH tariffs in Liberec increased to levels more than double than those of other Czech cities and towns (ERU 2014). The private investor’s ability to secure profits from the system was strengthened by its monopolistic position on the local DH market. At the same time, city authorities faced a conflict of interest between the economic aim to generate revenues for the municipal budget, on the one hand, and the political accountability to local citizens affected by price increases, on the other. Local politicians interviewed for the purposes of our study displayed a heightened sensitivity to the need to respond to public concerns:

The two city representatives work very actively on the [DH company’s] board to make decisions more transparent. Because they represent the interests of the local people, they form an opposition bloc on the board. (personal communication, Liberec public official, March 24, 2015)

The construction of a small CHP plant in a remote housing estate – principally aimed at reducing losses in the distribution network – has been the only attempt to decrease operational costs and make DH prices more affordable in the long run.

Unraveling DH price increases in Liberec

In line with circumstances observed elsewhere (Poputoaia and Bouzarovski 2010), the low-energy efficiency of Liberec’s DH distribution network has been central to the price problems faced by final consumers. Not only has the municipality failed to invest in the improvement of the distribution system to date, but plans to undertake future steps in this regard currently do not exist:
It is really costly, but because we don't know what we will do in the future, we cannot undertake the investment. Thus, we are just postponing it year after year. (personal communication, Liberec decision-maker, March 24, 2015)

Geographic factors have also played a role in driving price rises. Mountainous topography has hemmed the city into several valleys, thus lengthening the network and increasing technical losses. As stated by an administrative official:

The system is oversized, with large losses. They are due to the inefficient system of distribution, and low heat demand … We need a spatial plan to regulate district heating, like the one that was devised for Jablonec. That will give us an overview of the network. (personal communication, Liberec urban planner, March 24, 2015)

Another key factor in this regard has been the company's shrinking customer base. As was noted above, this decrease can be attributed to wider socioeconomic trends and local transformations alike. First, the downsizing or termination of the network's industrial consumers was accompanied by the imperative of achieving cost savings in the newly established market environment. Industrial, commercial, and public sector consumers sought to reduce their heat consumption in different ways, including using alternative fuels. Second, housing privatization meant that consumer decisions about heat supply and consumption became fragmented and individualized. Each building became represented by a homeowners' association – a far more complex arrangement than the one that existed during socialism, when the DH company only had to deal with government or industry officials as well as a small number of large housing co-operatives. After 1989 householders responded to increasing heating costs by improving the energy efficiency of their homes via facade insulation as well as the installation of new windows and infrastructures within the buildings. This was supplemented by fuel switching towards more efficient and affordable sources.

As a consequence of such trends, total heat use halved from 1943 TJ\(^1\) in 1997 (of which 53% were consumed by households) to 881 TJ in 2013 (at which point the share of the residential sector rose to 56%). At present, the DH system in Liberec generates only about 45% of its initial capacity, serving 16,417 households, 129 organizations (principally public administration and service buildings), and 13 industrial zones. The Termizo incinerator produces up to 1000 TJ of heat annually, approximately 70% of which are sold into the Liberec DH system. Because this supply covers nearly all of the city’s heat demand, the production capacity of the DH plant remains unused. Even though Termizo has recorded significant profits since 2004, its declining customer base directly contradicts original plans. The original DH network was intended to serve vast urban populations while creating economies of scale and scope in the provision of heat to urban agglomerations. At the same time, the system has fixed costs that have to be covered regardless of the actual volume of produced heat. Shrinking demand means that these costs are borne by ever-decreasing number of customers, signaling the demise of the city’s original plans to achieve cheaper heat with the aid of the new waste incinerator.
Barriers to fuel switching and DH development

While the inefficiencies of the central heating system are included in the final price, the DH company's customer base has been further undermined by the emergence of alternative supply options. There is a clear economic impetus behind this: our interviewees pointed out that the price of heat obtained from the Liberec plant is approximately 800 CZK per GJ, while individually installed gas boilers in flats and homes require 400 CZK per GJ (personal communication, Liberec city councilor, March 24, 2015). In response to the shrinking consumer base, local authorities have actively discouraged companies and housing blocks from disconnecting. Even if disconnection cannot be openly prohibited, the municipal administration has employed various practices, strategies, decisions, and planning policies to prohibit consumers from switching to more affordable or efficient technologies.

According to a decision of the municipal board made in 2008 (No. 591/08), the city’s planning office shall not endorse requests for the disconnection of buildings from the DH system. It is also instructed to disagree with the construction of new infrastructure for alternative heating in districts where DH systems are present.

In addition to planning regulation, our interviewees pointed to examples where home owners wishing to install gas boilers – DH's main competitor – have been prevented from doing so by the local authority on land ownership grounds, with the city prohibiting piped gas connections that would cross publicly owned territory.

Liberec has a gas network with sufficient capacity, although there are parts of the city that are remote from it. Still, even if you need to lay 30 meters of pipes on public land you need permission from the municipality, and they will not give it to you. Our organization has such court cases all the time … in the past we lost many of them, because the court decided that the city has the right not to allow its land to be used for purposes that are not in its interest. (personal communication, chairman of housing co-operative in Liberec, March 24, 2015)

While such restrictive measures may help prevent deeper cost inefficiencies and increasing price levels, they have rendered the existing network politically and technically precarious. The declining customer base means that DH now serves only a part of the overall heating landscape in the city. Any investment in its improvement – now desperately needed – would have to be funded by the taxpayer. As DH is primarily a private business, how and where profits are distributed becomes a politically sensitive issue, as does the cleavage between private and public interests:

For example, politicians who are on the [DH plant's] advisory board get big salaries for just sitting on it. These are not activities that politicians should do, and they are not protecting the interests of the city there. (personal communication, Liberec city councillor, March 24, 2015)

An additional challenge is posed by the spatial distribution of the DH system in Liberec, which itself was not originally built to provide heating to all consumers. The network does not include residential areas with low-rise family housing,
older inner-city neighborhoods, villages in the urban hinterland, and recently built suburbs. DH provision has been primarily targeted towards high-rise and spatially concentrated housing estates from the socialist era. Disconnections from the system are most difficult to implement in such districts, some of which are facing wider problems of social decline and outmigration. Their specific and geographically bounded population is being trapped in the vicious circle of technical inefficiencies, shrinking consumer numbers, profit imperatives, and increasing end-use prices. Paradoxically, a system that was originally meant to provide greater levels of economic efficiency, social equity, and environmental sustainability now serves an increasingly impoverished population with the most expensive form of energy.

A complex lock-in through rolling path dependencies

The multiple drivers of price increases and barriers to DH development indicate the presence of a complex lock-in with at least four aspects. First, there is an infrastructural dimension embedded in historical legacies. DH systems – which were planned and constructed under socialism in order to meet the needs of growing populations and industrial production – are now faced with a shrinking inner city and suburban sprawl (in line with wider trends in Eastern and Central Europe, see Großmann et al. 2013; Petrova et al. 2013; Stanilov and Sýkora 2014), which is technically and economically unsuitable for the delivery of centralized heat supply. A network designed under the former socioeconomic system thus not only functions sub-optimally under current market conditions, but its sub-optimality is being further deepened by external and internal systemic pressures:

[D]uring the last two decades it has been known that the capacity of the distribution networks … [will remain unused] … because of the exclusion of industrial capacities that do not exist anymore, or decided to disconnect. For almost two decades it has been known that the system is inefficient because the capacity is very high, the pipes are very wide and it would be good to transform it into a system of hot water instead of steam, and make it into something smaller. Unfortunately there has been no investment into this direction during the last decade. (personal communication, Liberec city councillor, March 24, 2015)

Second, the DH system is technically and economically locked-in by cost inefficiencies and subsequent high prices for heat attributed to the technical conditions inherited from socialism. The need to undertake new investment to overcome this heritage is undermined by the downward spiral of shrinking customer numbers leading to further heat cost increases. Third, the lock-in is also political and institutional. Challenged by the privatization of key parts of the system, as well as the broader marketization of heat supply in the country, local decision-makers have attempted to resolve the DH crisis using restrictive measures that limit the choices available to citizens and firms. An alternative to these measures would be the commitment of public funds towards system upgrades, serving only some
citizens while adding to the private company’s profits. For the local authority, this leads to conflicts of interest and accountability towards DH customers, on the one hand, and the diverse range of urban actors who are not linked to DH system, on the other:

The other problem is that the waste burner produces the same amount of energy as the heat plant, and during the summer they do not know what to do with that energy … So, now we have a counter-argument to the one that was presented to the public a few years ago … [they are telling us that] if the district heating system collapses Termizo will have problems and you will pay much more for the waste collection … So we would have exorbitant prices for waste collection, in addition to the charges levied by Termizo … The heat lobby is very strong – regardless of any consumer rights that are demanded, they always manage to destroy any attempts to change the regulation. (personal communication, chairman of housing co-operative in Liberec, March 24, 2015)

Fourth, the lock-in has a clear socio-spatial aspect. The geographic concentration of DH in housing estates built during socialism supplants the technical and political barriers towards fuel switching, forcing the population to purchase heat from a single private provider. The inability to move away from DH is thus concentrated in geographically distinct areas, whose precarious position is heightened by high heat costs. Municipal authorities presently have no plans to address this situation:

The law does not permit the company to establish special prices for specific social groups. The prices depend on the energy source – whether it is heat or steam – and the distance and size of the customer. (personal communication, urban planner, March 24, 2015)

Neoliberal marketization, deregulation, and decentralization have created a paradox wherein a heating supply system that can potentially be economically efficient, socially inclusive, and environmentally friendly (Rezaie and Rosen 2012) has evolved into a costly economic burden that deepens inequality and exclusion. While sustainability, cohesion, and energy efficiency have now become key goals of public policy, they were downplayed in the initial days of the post-communist transformation. But the sequence of decisions made during the past 25 years has created a rigid socio-technical matrix that is resistant to change. This lock-in has developed through a rolling path dependency that involves socialist legacies, national economic reforms, and local neoliberal practices. The path dependency is associated with socially and economically detrimental effects while preventing the development of more sustainable systems of energy provision. It demonstrates that the combination of socialist legacies and chains of decisions taken during the post-socialist period may result in situations and trajectories that themselves will be difficult to address for the years to come: living in and with capitalism is an ongoing project.

**Conclusion**

This contribution argues in favor of the persistent relevance of post-socialist urban studies by highlighting how socio-technically and politically conditioned
lock-ins arise, are articulated, and become embedded within urban areas via rolling path-dependent processes that have emerged after 1989 while stemming from past legacies. Inspired by a growing conceptual interest in processes of path dependence and path creation across a wide range of disciplines, we focused on the choices made by institutional actors after the demise of state socialism and the impact of past legacies and market conditions on decisions made at critical junctures. We proposed and used an interpretative rather than normative model of lock-in formation, by elucidating the sequences of decisions involved in the consolidation of a particular path-dependent trajectory.

At the same time, the notion of rolling path dependencies has allowed us to trace the roots of the current lock-in within Liberec's heating system to a combination among the legacies of DH infrastructures inherited from socialism, national policies towards energy restructuring, and the reform of DH systems after 1989, as well as the approaches adopted by local governments with regard to the management of such networks. The continued role of path-dependent trajectories – present in the form of inherited technical infrastructures that have been re-used by capitalist market actors for profit-making purposes – underlines the need for a temporally and spatially sensitive perspective on the understanding of urban transformations in CEE and the FSU.

Thus, and to summarize, what can a theoretical perspective attuned to the systemic relationships that the multiple transitions in CEE and the FSU offer to the wider world of “posts?” For one, it brings attention to the need for understanding post-socialist change through a lens that is both temporal and spatial, by acknowledging that infrastructural development trajectories are closely integrated with inherited, existing, and evolving urban landscapes. Second, it calls for making connections between the urban implications of infrastructural transformations in the post-socialist world, on the one hand, and analogous dynamics of socio-technical change in other spatial contexts, on the other: not only because of the ubiquitous background presence of neoliberal pressures, but also due to the significant opportunities for knowledge transfer about the establishment of unintended material and institutional rigidities. Of particular relevance is the ongoing global effort to move toward a low-carbon future, predicated upon deep reforms in the manner in which energy is produced and consumed. Applying the experience of post-socialist countries to this thematic context may allow for path creation to be seen beyond the tropes of technological innovation and economic development that presently dominate much of the literature. It can also highlight the deeply political nature of the creation of new lock-ins, as well as the challenges of dealing with new path-dependent situations.

Notes

1. A terajoule equals one trillion joules (10^{12}).
2. A gigajoule equals one billion joules (10^9).
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