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TURNING ATTENTION TO THE AFTERLIVES OF KNOWLEDGE INFRASTRUCTURES

Once a large-scale infrastructure such as a railroad, sewage system or power plant is put into place, it not only tends to enjoy a long life, but often also a forceful afterlife. Abandoned railroads may find new uses, while ruined sewage systems or power plants tend to have toxic legacies that continue to make people sick. When infrastructures cease or fail to provide the functions for which they were originally intended, they do not cease to interact with and alter their environments. Rather, they remain as lively remnants that continue to order relations and exert influence (Appel et al. 2018; Barry 2020; Sizek 2021).

In this short piece, we take our cue from recent infrastructure studies that have focused on the processuality and temporality of infrastructures (e.g., Anand et al. 2018; Carse 2019; Gordillo 2014). We extend this approach to knowledge infrastructures—or the support systems and networks that lay the conditions for particular modes of governing—and ask what kinds of afterlives they may have. To assess these, we examine the continuities present as international climate policy transitioned from one regime—the Kyoto Protocol —to another—the Paris Agreement. Our main argument is conceptual: we, first, argue that knowledge infrastructure is critical for enabling particular modes of climate governance. Second, we point out that knowledge infrastructures also need to be critically examined through a temporal lens, asking what their continued influences and lingering power effects are. We close with remarks on the possibilities for research opening up from examining the afterlives of knowledge infrastructures.

Infrastructure has been the subject of much attention in the social sciences, ranging from science and technology studies (STS) to anthropology. The focus of a large part of such studies has been placed on physical infrastructures and the dis/connections they generate and/or mediate (Anand et al. 2018; Harvey et al. 2017; Larkin 2013) as well as on the processes of 'infrastructur*ing*', which rearrange human and nonhuman relations, while rendering environments infrastructural (Blok et al. 2016; Barua 2021). At the same time, the role of less material infrastructures has received a smaller amount of attention. To address this gap, we draw on earlier literature on infrastructure in STS to specifically consider knowledge infrastructures.

Discussing the sociotechnical support systems enabling the generation and circulation of scientific knowledge, Paul Edwards (2010: 7) defines knowledge infrastructures as 'robust networks of people, artefacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds.' However, our interest extends beyond Edwards' focus on scientific knowledge to being interested in acts of governing—or how knowledge infrastructures enable and are co-constitutive of certain forms of climate governing while foreclosing on others. We define knowledge infrastructures as a durable assemblage of

interacting governing rationalities, calculative devices, accounting methodologies, standards, and experts that form the basis for and enable particular modes of governing. To elaborate on this, we next turn to discussing international climate policy and carbon offsetting.

Adopted in 1997, the Kyoto Protocol marked the first comprehensive international treaty to address climate change. It also established several market-based policy mechanisms for dealing with climate change, including the creation of carbon offsetting through the Clean Development Mechanism (CDM). Carbon offsetting refers to the practice of paying another entity to reduce, avoid or sequester emissions somewhere else, in order to compensate for or offset emissions. In the case of the CDM, industrialised countries in the global North could meet part of their emission reduction obligations by purchasing supposedly more 'cost-efficient' carbon credits produced in the global South.

In this context, we take knowledge infrastructures to refer to the assemblages enabling offsets to exist as tradable commodities and entities of climate policy. For example, carbon offset units need to be legally and technically defined in order to exist in a commodity form and to be able to travel from one place to another (Mackenzie 2009; Dalsgaard 2013). A series of obligatory passage points (Callon 1984), such as technical calculations and processes of monitoring and reporting, exist which offset projects must pass through before being accepted as tradable carbon credits. Without such knowledge infrastructure and the expert work it supports and enables, carbon offsets would not exist. A tree planted in India would simply be a tree planted in India. A carbon offset becomes real only 'through all those processes of validation, verification, issuance' (Lobbyist, quoted in Blum 2020: 232). Thinking about carbon offsetting as dependent upon and contributing to knowledge infrastructures opens up new avenues for examining climate policy and its governance.

Knowledge infrastructures, just as any other infrastructure, are subject to modification, maintenance, refinement, and change. The extent to which knowledge infrastructures are malleable or result in obduracy and lock-ins needs to be addressed empirically. As the Kyoto Protocol was ending, the Paris Climate Agreement was negotiated in 2015. The Paris Agreement provided a moment to think anew about the role of policy mechanisms in climate governance. It brought to the fore the substratum of climate policy, or the distinct calculative devices, methodologies, and expert networks enabling climate policy mechanisms such as carbon offsetting to function.

The main difference between the Paris Agreement and the Kyoto Protocol is the shift from imposing quantified emissions reduction obligations on a group of industrialised countries (Kyoto Protocol) to committing all signatories of the Agreement to propose climate mitigation activities of their own (Paris Agreement). As all signatories aim for mitigation activities, there no longer exists a so-called surplus of 'cheap and efficient' emissions reductions in the global South which industrialised countries from the global North could finance and claim. This opened up the possibility of moving away from an offsetting logic in international climate governance to renew commitments to emissions reductions. However, what countries agreed to in signing the Paris Agreement was not at all clear. In particular, Article 6, which outlines the role of voluntary cooperation between signatories, entailed vague language and remained a source of heated debate. In fact, Article 6 prevailed as the last unresolved piece of the Paris 'rulebook' with continuous failures upon which parties

could reach agreement prior to the COP26 in Glasgow in 2021.

In relation to international carbon markets, the Paris Agreement posed a threat to several actors since it potentially signalled an end to offset-based carbon markets. Given this reality, carbon market actors rapidly mobilised around the methodologies, processes, and capacities—or the knowledge infrastructure—created during the Kyoto Protocol. As a speaker at a COP24 side event organised by the CDM Executive Board commented, 'Not finding a place for the CDM will mean lost infrastructure' (UNFCCC News 2018).

The negotiations at COP26 in Glasgow resulted in a compromise deal that extended Kyoto-era carbon market mechanisms to the Paris Agreement. When examined as a knowledge infrastructure, we see significant parallels between the two, with largely the same networks of experts, data, and methodologies established during the Kyoto Protocol re-purposed to fit the Article 6 requirements in the Paris Agreement. Years of work using the Kyoto mechanisms helped create the knowledge infrastructure that enabled the first global carbon market. Following COP26, governance bodies established during the Kyoto Protocol offered alongside the novel policy instruments the 'hard and soft infrastructure that has been built up over many years in support of the CDM' (UNFCCC 2022). This demonstrates how the assembled networks of experts and methodologies have inertial powers that have kept the mechanisms alive. It also reflects how infrastructure is oftentimes developed or built upon existing structures (Appel et al. 2018; Barry 2020).

The continuity of offset-based climate governance represents a combination of infrastructural persistence and powerful political interests pushing for the endurance of carbon offsetting. At COP26 in Glasgow, industrial lobbyists approached Article 6 as the key mechanism for enabling corporate net zero pledges and accelerating the establishment of global carbon markets. The will to make climate ambitions 'easy', undisruptive, and business-friendly through sustaining carbon offsetting has, thus, been coupled with the lingering power effects of knowledge infrastructures that already exist and can easily be mobilised.

Following COP26, new questions emerge on who will have access to cheap credits or the so-called low hanging fruits that the previous offset mechanisms targeted: the governments of the global South that now have their own emission reduction commitments or the corporate and government buyers in the North? Furthermore, the problems of carbon commensurations remain and intensify with the new Paris rules put into place through Article 6. Creating commensurability will require hard infrastructural work as significant modifications of calculative devices are required to make them fit for the post-Paris realities of climate governance and accounting. Moreover, this work is largely expected to be done by the same experts trained in carbon offsetting during the Kyoto Protocol. In the worst-case scenario, new forms of infrastructural violence may become engendered, perpetuating the kinds of harms caused by previous offsetting mechanisms (Cavanagh and Benjaminsen 2014; Carton and Edstedt 2021; Käkönen and Thuon 2019; Milne and Mahanty, 2019; Rodgers and O'Neill 2012).

If abandoned mines or power plants continue to pollute and affect their surroundings, what happens to seemingly obsolete policy mechanisms? Or, rather, what happens to the knowledge infrastructures that form the foundation and substratum of such policy mechanisms? Like unused railroads, such knowledge infrastructures do

not merely disappear. Instead, they continue to exert influence as networks of experts, data, and methodologies that can be brought up and retrofitted. Using our example on carbon offsetting trajectories, we hope to have highlighted the relevance of attending to such afterlives. By revealing infrastructural inertias, such an analysis also has the potential to contribute to the infrastructural repurposing and reimagining required to leverage more liveable and just futures.

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