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Abstract

The circular economy (CE) is argued as a possible model for dealing with value chain instabilities in global production networks. Since geographical proximity is central to unlocking circular potential, x-shoring (including concepts like reshoring, resourcing, or friendshoring) is arguably key to this process. Often, spatial restructurings of the CE are embraced without a critical examination of their multi-scalar effects. Nevertheless, spatial restructuring of the economy inevitably produces winners and losers. To navigate the tensions that arise in the context of uneven development and environmental (in)justice, we present a framework for anticipating plausible socio-economic and socio-environmental effects of x-shoring processes across place, scale, and time. We illustrate our framework with insights from the literature on old industrial regions and cases documented in the Environmental Justice Atlas. Our framework represents a holistic approach that integrates interdisciplinary literature from different disciplines. We discuss the ambivalent effects of x-shoring across space, scale, and time, principles for navigating the tensions that arise, and outline research avenues for a thorough exploration of the geography of x-shoring in the CE and beyond. Because of the ambivalence of these processes, we conclude that research must embrace the complexity of these developments by employing integrative, multi-scalar approaches that empower local agency.

Keywords: global production networks, global value chains, trade-offs, circular economy, anticipation

JEL codes: F63, F64

1 Introduction

Climate and environmental change and uneven development, including cheap labor and unjust working conditions, increasingly highlight the need for changes in the global configuration of production and consumption systems. In the wake of emerging geopolitical tensions over Russia's invasion of Ukraine and supply chain instabilities during the Covid-19 pandemic, firms are rethinking their global entanglements in financial, material, and trade flows, and policy makers are evaluating their instruments in steering development (Butollo et al. 2024; Di Stefano et al. 2023; Yeung 2024).[1]

Consequently, actors and regional economies in global production networks (GPNs) may get 'decoupled' or 'recoupled' (e.g., Blažek and Lypianin 2024; Pavlínek 2023; MacKinnon 2011). Scholars are increasingly discussing these crises as 'windows of opportunity' for more sustainable supply chains and sourcing (e.g., Alva Ferrari et al. 2023; Ibn-Mohammed et al. 2021). In particular, the circular economy (CE)[2] is discussed as a concept and a model which contributes towards closing material loops and helps to design a less crisis-prone and resilient economy (Hartley, Baldassarre, and Kirchherr 2024) alongside creating new job opportunities in home regions such as the European Union (EU). For example, the EU estimates a GDP increase of 0.5% by 2030 alongside 700,000 new jobs in terms of advancing the CE (European Commission 2020). An increasing number of conceptualizations of the CE include fundamental systematic shifts, rather than incremental change (Kirchherr et al. 2023). Consequently, a

[1] The UNCTAD (2023) describes a 12% decrease in FDI (foreign direct investment) in 2022 mainly driven by overlapping crises such as geopolitical tensions and high food and energy prices.

[2] There is no prevailing or universal definition of the CE, as it is a concept that involves values and normative goals of what ought to be. Therefore, the CE appears rather as an umbrella term for different (and contested) meanings among different stakeholders (e.g., Calisto Friant, Vermeulen, and Salomone 2020; Leipold et al. 2022), leading to a considerable number of definitions of the CE. In a meta-analysis of these definitions, Kirchherr et al. (2023) find that it is discussed as "a regenerative economic system which necessitates a paradigm shift to replace the 'end of life' concept with reducing, alternatively reusing**,** recycling, and recovering materials throughout the supply chain, with the aim to promote value maintenance and sustainable development, creating environmental quality, economic development, and social equity, to the benefit of current and future generations. It is enabled by an alliance of stakeholders (industry, consumers, policymakers, academia) and their technological innovations and capabilities." (p. 7). We are aware of the contestation surrounding the CE and its definitions. We refer to the CE based on the overview by Kirchherr et al. (2023) to show the breadth of the concept.

transition to a CE in the global economy (Hofstetter et al. 2021) may encompass a substantial spatial reorganization and regionalization of specific components of the economy, as geographic proximity emerges as a key aspect in the production, consumption, and end-of-life stages within certain industries and among stakeholder within the CE (e.g., Chembessi, Bourdin, and Torre 2024; Kim 2024; Korhonen, Honkasalo, and Seppälä 2018). We refer to this process under the umbrella term '*x-shoring*', referring to phenomena such as reshoring, resourcing, or nearshoring (Di Stefano et al. 2023; James, Mather, and Sheridan 2023).

However, reorganizations of the global economy will create (new) 'losers' (Bair and Werner 2011), such as regions in host countries (sites of current production or sourcing) with less power, resources, and capabilities to transform in the moment of decoupling. With a large number of regions in the global North continuously struggling as 'left behind' after previous restructurings (Pike et al. 2023; Rodríguez-Pose 2018), this spurs questions regarding the navigation of justice and responsibility of the CE as well as the regional legitimacy of these developments. While justice and responsibility are increasingly being discussed within the CE literature (e.g., Purvis, Celebi, and Pansera 2023; Schlaile, Friedrich, and Zscheischler 2024; Ziegler et al. 2023), the *geography* of these aspects regarding spatial reconfigurations of the global economy remains only tangentially explored, if not neglected.

We argue that in order to design and govern more *just* circular transitions, where more (equal) opportunities and participation for different actors in the global North and South can emerge, it is necessary to become aware of the *geography* of *potential* effects and trade-offs of currently unfolding developments. Perceptions of these potential prospects are subject to actors' positions and power dynamics, influencing how and which risks and uncertainties are perceived.[3]

[3] The dark sides, side effects, and trade-offs discussed are mostly related to issues of distributive justice. However, their perception and the question of who is to participate in decision-making processes are also linked to issues of recognition and procedural justice, see, e.g., Bennett et al. (2019).

The concept of responsible research and innovation ([RRI], see Owen, Macnaghten, and Stilgoe 2012; Stilgoe, Owen, and Macnaghten 2013) emerges as one way of designing and navigating just circular transitions (Purvis, Celebi, and Pansera 2023). Stilgoe, Owen, and Macnaghten (2013) define RRI as "taking care of the future through collective stewardship of science and innovation in the present." (p. 1570). RRI is characterized by four dimensions, namely anticipation, reflexivity, inclusion, and responsiveness (Stilgoe, Owen, and Macnaghten 2013; Purvis, Celebi, and Pansera 2023). In this paper, we build on the notion of *anticipation* as a key dimension of RRI to anticipate the potential effects of circular changes in the global economy. Anticipation refers to 'what if' questions (Purvis, Celebi, and Pansera 2023). Usually, anticipation of changes is grounded in scenarios or vision assessments with different stakeholders that are oriented towards the future and potential impacts of innovation (Stilgoe, Owen, and Macnaghten 2013).

However, as our interest lies in the spatial reorganization of CE in GPNs that couple various actors and places (e.g., Yeung and Coe 2014; Dicken 2015; Henderson et al. 2002), a visioning process across space (and actors) is difficult to realize. In addition, spatial reorganization involving the geography of innovation takes place over a long time (Fischer et al. 2024) and is therefore difficult to anticipate because of its long-lasting effects. Therefore, we situate our anticipation of possible effects and trade-offs in existing knowledge of historical and currently unfolding processes of spatial reorganizations. In that, we can outline potential effects and risks in terms of *plausible* futures rather than making concrete statements about what will happen (Nordmann 2014).

Against this background, our aim in this paper is to outline a multi-scalar approach that can guide the anticipation of the socio-economic and socio-environmental effects of x-shoring across space and time. With socio-economic and socio-environmental effects, we aim to combine a perspective on aspects such as regional development and innovation with issues of

socio-environmental conflicts and impacts on biodiversity. This is based on the understanding that socio-economic processes always have a socio-environmental dimension (e.g., Temper et al. 2018; Österblom et al. 2022; Folke et al. 2005). We illustrate this approach by mapping plausible consequences of present x-shoring developments. This will be based on examples of spatial restructuring related to 'old industrial regions' (OIR) and the (long-lasting) socio-economic and socio-environmental effects in these regions. Additional insights will be gained from socio-environmental struggles around mineral extraction and production sites in (among others) the Global South (EJAtlas 2024; Temper et al. 2018).

By mapping plausible effects associated with x-shoring, we aim to sensitize scholars working on the CE to more carefully embrace the geography of circular transitions in GPNs. The paper proceeds as follows: First, in Section 2, we briefly situate x-shoring and its multiple drivers and motivations. Next, we present our conceptual framework and illustrate the plausible effects of the spatial restructuring of the economy. Finally, we outline how our approach informs the governance of responsible circular transitions in the global economy and identify opportunities for future research.

2 Spatial restructurings: Situating x-shoring

Different types of spatial reorganizations of economic activity can be discussed under the term x-shoring, not all of which are necessarily related to some kind of sustainable or circular-oriented change. We discuss these phenomena to gain insights into the nature of processes, and to better understand spatial restructurings that can be linked to circular transitions in GPNs. By the term x-shoring, we consequently refer to what is discussed as nearshoring, friendshoring, resourcing, backshoring, newshoring, insourcing, and de-internalization, among others (Di Stefano et al. 2023; James, Mather, and Sheridan 2023). This links to what is discussed as a ‘globalization in reverse’ (Gong et al. 2022) or ‘deglobalization’ (Yeung 2024) and is

significantly influenced by industrial policies, such as the US Inflation Reduction Act (Buttolo et al. 2024). However, the extent and impact of these phenomena on the global economy varies, and Butollo et al. (2024) argue that these processes may not necessarily replace the global economy with local versions, but rather that new regional clusters will emerge that nonetheless reorder the global economy.

In what follows, we briefly outline drivers and motivations of these processes discussed in the literature. We focus in particular on spatial restructuring related to the sourcing of materials and the production of goods, as these aspects emerge as key components of the idea of closing material loops in the CE. The literature discusses a variety of motivations and drivers for these processes that we group in (a) (state-induced/led) political-legislative changes that shape change, (b) firm-specific considerations, and (c) the role of consumers in shaping these shoring decisions. In practice, these three aspects often overlap and complement each other, as firms' decisions are fueled by wider consumption choices and firms' embeddedness in different institutional environments across the GPN (across locations, e.g., Henderson et al. 2002).

In terms of (a) (state-induced/led) political-legislative aspects, drivers for x-shoring are currently particularly discussed related to industrial policies stemming from geopolitical tensions and sovereignty considerations of states and transnational bodies supporting the x-shoring activities of firms (Butollo et al. 2024; Seidl and Schmitz 2023). To exemplify, the EU favors technological sovereignty related to aspects such as 'control over our data and secure connectivity' as well as 'technological autonomy' regarding defense technologies and green tech (European Parliament, Directorate-General for External Policies of the Union, 2021). The European Commission's Raw Materials Initiative (EC, 2008) encourages sourcing of minerals from within the EU. These considerations shape industrial policies and states incentives to relocate economic activity 'back home'. These type of policies also provide financial incentives, often in the form of subsidies. Regarding (technological) sovereignty, the U.S. e.g.

supports TSMC's x-shoring to Arizona with $6.6 billion (Shepardson and Kelly 2024), and the EU Commission approved Germany's €902 million financial support for Northvolt based on the "Green New Deal Industrial Plan" (European Commission 2024). Kalvelage and Tups (2024) complement this state-focused perspective by conceptualizing friendshoring as a practice of outward-oriented investment by states in neighboring countries ('friends') that often share similar values. In particular, the authors (ibid.) discuss how states' investment decisions in friendly countries are driven by geopolitical considerations related to energy or food supply, which often provide institutional support for de-risking private investment in these countries. In addition to these state-led incentives with subsidies from states and transnational bodies such as the EU, civil society and NGOs can play a (often much smaller) role in shaping new legislation that (re)organizes GPNs. An example of this can be found in Germany, where such actors have been advocating for more responsible supply chains for more than 20 years. Together with the German National Action Plan on Business and Human Rights, this led to the German Supply Chain Due Diligence Act (Weihrauch, Carodenuto, and Leipold 2022). According to the prospective study of Brandenburg, Warasthe, and Seuring (2023), this act will influence firms' decisions to leave 'crisis markets' and lead to x-shoring activities.

From a (b) firm perspective, different aspects may lead to x-shoring decisions. These can relate to the adoption of new technologies and a better-trained workforce in the country to which it is shored (e.g., Technology 4.0, cf. Lund and Steen 2020), cost reduction (Ancarani, Di Mauro, and Mascali 2019), and correcting wrong offshore decisions (Ancarani and Di Mauro 2018). According to James, Mather, and Sheridan (2023), x-shoring can also relate to (i) industry leadership, i.e., strengthening the position and reputation at home and boosting the national economy, (ii) prioritizing sustainability (and reducing the environmental footprint), (iii) reconnecting with consumers and increasing their trust through the 'made-in' effect (see also below), and (iv) production risk mitigation, i.e., increasing control over production and

reducing risk in supply chains (see also Ancarani, Di Mauro, and Mascali 2019; Sena et al. 2022). Additionally, Ancarani, Di Mauro, and Mascali (2019) suggest that spatial proximity to important markets or the reduction of global competition are major drivers of x-shoring. Finally, sustainability-oriented or environmental motives can also lead to x-shoring. Di Stefano et al. (2023) argue that reducing CO_2 emissions due to decreased transport, a less polluting 'power mix' in the home country, reducing overproduction and waste, implementing CE projects, adopting; more innovative and cleaner production technologies, and enhancing the cohesion between firms' strategic aims and their operational policies shapes firm's decisions. Positive side outcomes of these aspects are being closer to key markets and reducing supply chain risks from international trade and material sourcing. Di Stefano et al. (2023) outline that better environmental standards for production in countries to which production is x-shored and reduced transport distances may lead to improved environmental performance overall.

Regarding (c) consumers, there are arguments in the literature that highlight a preference for nationally produced goods (also discussed as 'consumer ethnocentrism', see Foroudi et al. 2022; or 'made in effect', see James, Mather, and Sheridan 2023), which are perceived as contributing to the sustainability of the home country, as shown in Italian case studies (Foroudi et al. 2022; Gillani, Kutaula, and Budhwar 2022). However, some studies suggest that consumers may also question the sustainability effects of x-shoring if they feel emphatic about the loss of jobs in former host countries (Foroudi et al. 2022). Accordingly, consumers choices vary depending on the product, firm, and context and, hence, influence x-shoring decisions of firms in different ways. Consumers in countries with a strong affinity for national production (such as in Italy, see e.g., Foroudi et al. 2022) may function as a complementary incentive for companies to x-shore their activities.

This brief overview has sought to illustrate the motivations and drivers of x-shoring processes. In the next section, we will outline a multi-scalar approach to the anticipation of socio-economic

and socio-environmental effects across space that these spatial-economic reorganizations translate into.

3 A multi-scalar approach to socio-economic and socio-environmental effects of x-shoring

As outlined in previous sections, a variety of actor groups including states, policy makers, producers, and consumers, engage in and consequently shape x-shoring decisions in the pursuit of multiple motivations. These range from aspirations to ensure national security and technological sovereignty, enhance job opportunities, reduce the environmental impact of existing production facilities, reduce distance between markets, or enhance firms' competitiveness. Actors also aim to legitimize x-shoring with reference to societal benefits. However, the rationalization of x-shoring activities as well as the study of its effects fall short of a comprehensive geographical assessment, i.e., not paying sufficient attention to interdependencies between home and host countries, and the local and global effects at the interface between socio-economic and socio-ecological systems. In the literature, increased global interconnection, intensified by technology, capital markets and systems of governance, has been linked to deteriorating local ecosystems and biosphere negatively affecting regions and communities (Folke et al. 2005). The negative effects on biodiversity, ecosystems, and health have particularly been linked to multinational companies actions (Österblom et al. 2022) operating in GPNs. However, does a reverse process mean that global disintegration and increased local production (as implied by CE-driven x-shoring) will have positive effects on local ecosystems and the biosphere? And what are the social and socio-economic implications of such processes? In the following, we will try to provide answers to these questions by delineating a framework for a comprehensive and multi-scalar assessment of x-shoring.

We argue that three analytical distinctions need to be considered when comprehensivly assessing x-shoring: i) the effects on both home and host countries, ii) the scale of the effects from local to global, iii) the temporality of the effects from short- to long-term These three aspects need to be investigated concerning dimensions of sustainability, which we group into a socio-economic and a socio-environmental domain. This is illustrated schematically in Figure 1. The socio-economic domain includes aspects such as labor, income, regional development, and innovation. In the socio-environmental domain, we discuss aspects such as conflicts over resources, impacts on the biosphere and biodiversity, and spatial transformations.

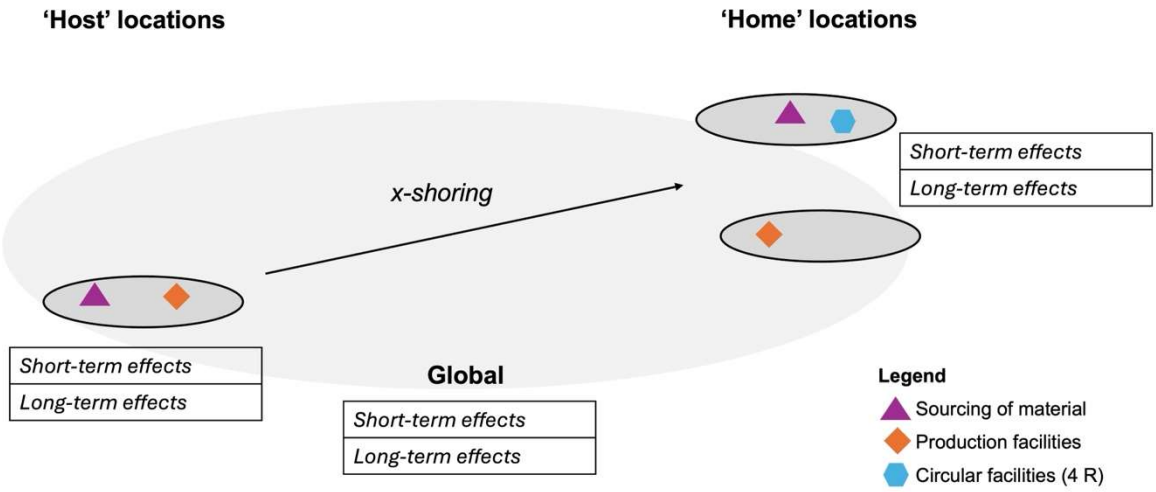

Figure 1: Multi-scalar dimensions of x-shoring for analysing the multidimensional socio-economic and socio-environmental effects.

i) **Home and host country**: The differentiation between home and host countries is common in work on globalization, GPNs, and global value chains. The strategies of firms to relocate functions from home to host countries are explained by market or asset seeking strategies (Dicken 2015). Multiple studies have shown that the economic benefits of such relocations are distributed unevenly, largely depending on the governance of global value chains (Gereffi, Humphrey, and Sturgeon 2005). In particular, hierarchical or captive relations, with high-level functions in the home country and control activities in the host country, create high dependencies and lock-in of host countries in low-skill and low-income activities

(MacKinnon 2011). However, as illustrated especially by several Asian countries, global value chains make it possible for host regions to upgrade and develop high-value activities (Saxenian and Sabel 2009). Furthermore, in former industrial regions, outsourcing and subsequent decline have led to the development of 'left behind' places (Economist 2017) and OIRs. Related to x-shoring, the relation between home and host countries needs to be reassessed. For a comprehensive assessment, a better integration of effects in the socio-economic and socio-environmental domains is necessary.

ii) **Multi-scalarity**: Within the literature on social-ecological systems, scales have played an important role, emphasizing that human actions have effects at different scales from local ecosystems to the biosphere (Folke et al. 2005). The scale of governance rarely matches the scale at which socio-economic processes affect the environment and vice versa. In addition to that, studies focusing on regional (industrial) development emphasize the need to better consider multiple scales of analysis (Hassink, Isaksen, and Trippl 2019). The argument is that development processes unfolding in a regional context are always embedded in multi-scalar networks and institutional architectures. Regarding x-shoring, the analytical lens needs to go beyond an investigation of scales from a hierarchical perspective (i.e., nested scales from local to global) but also in a vertical perspective, i.e., the relations between two local scales – the home and host countries, as well as the effects that result from the interplay between the two local scales, and at the global level. The differing formal institutions between home and host countries is a factor that outsourcing firms have used to their advantage for a long time (Di Stefano et al. 2023).

iii) **Temporality**: Recently, there has been a call to better take into account temporality in geographical analysis (Henning 2019; Martin and Sunley 2022). This is particularly important for the anticipation of potential outcomes of x-shoring. While purely static economic analysis may capture short-term effects like job losses, they are poorly equipped

to assess long-term outcomes. To understand these, aspects like (un)learning or the development/destruction of capabilities, and relatedly changes in the innovation ability need to be considered. What in the short-run may be a cost-efficient solution can in the long-run undermine capabilities and competitiveness. New jobs and income opportunities may in the long run develop lock-ins in unproductive economic activities. Furthermore, there appears relatively limited attention in the scholarly literature to the temporality in the interface between socio-economic and environmental domains. So, what consequences will current x-shoring have in the short and long run?

4 Learning from the past to anticipate the future: A geographical perspective on effects of spatial restructurings

Since the effects of emerging x-shoring in the context of CE in GPNs are largely in the future, we suggest that there are lessons to be learned from past economic restructuring processes and environmental justice struggles when anticipating plausible effects and considering the governance of just circular transitions.

When competition between firms led to 'spatial fixes' (Dicken 2015), i.e., outsourcing to locations with lower wage levels and more relaxed social and environmental legislation, the structural preconditions of the former home locations created particularly difficult conditions for structural change and renewal. Many of these regions had become over-specialized (Coenen, Moodysson, and Martin 2014), regionally locked-in (Hassink 2010), and reproduced the set industrial path rather than diversifying (Stihl 2022) or recovering. Today, 40-50 years later, many of these regions are still struggling, often referred to as 'left behind places' (Pike et al. 2023). These restructuring processes also have an often-neglected socio-environmental dimension. The production or the sourcing of materials brought local effects on residents and

ecosystems, as documented in the EJ Atlas (Temper et al. 2018), and affected planetary boundaries, such as biogeochemical flows and CO_2 (Österblom et al. 2022).

Next, we present a *non-exhaustive* set of these socio-economic and socio-environmental effects attributed with past restructuring in OIRs or to the broader literature on environmental justice. The impacts are summarized in Table 1 at the end of the chapter. An extended version of the table (including references) can be found in Appendix 1.

4.1 Local socio-economic effects

The effects of x-shoring in *home* regions may mainly be regarded positive as the restructuring may bring 'back' jobs that have been previously outsourced. In particular, the CE is expected to lead to the creation of new jobs in the EU (European Commission 2020), some of which may result from x-shoring. Half of these new jobs is estimated to be low-wage and labor-intensive types of jobs (Llorente-González and Vence 2020). Given that explanations for the current challenges in OIRs are the reduction of manufacturing jobs, as well as "favouring the mobility of highly skilled, non-routine and creative jobs" (Iammarino, Rodríguez-Pose, and Storper 2017: 1), an increase in low-skilled labor-intensive jobs may be beneficial for several regions. It should be noted that new jobs may not be relocated to where they were previously placed. If we look at the large-scale production facilities currently being built in connection with the green economy (e.g., battery factories), we see major efforts by various localities to secure the factories in their respective region. With continued x-shoring and a growing CE, labor competition between industries, companies, and regions may increase, especially since many home countries already face increasing labor shortages due to demographic change. This may result in increasing labor (also i.e., production) costs.

From a more *long-term perspective*, some of the short-term effects may persist, such as increased employment levels, labor competition (like high-qualified labor in India), and labor

costs, yet these can be reduced with increased automation. Value chains may become more stable compared to recent years of instability (e.g., pandemic years, material shortages, shipping constraints, etc.), linked to issues of technological sovereignty (e.g., European Parliament et al. 2021). Given stronger environmental legislation and workers' rights in the Global North, x-shoring is also expected to drive socio-technical innovation (Di Stefano et al., 2023; James et al., 2023). X-shoring may create more circular opportunities, such as those related to novel circular innovations, material recycling, servicing, and second-hand sales. This may also be driven through regional investments that can drive knowledge spillovers and enhanced innovation capabilities, which can lead to further development such as new industrial growth paths. Spillovers will vary depending on the location of the investment. In recent decades, more metropolitan regions have been favored in terms of agglomeration economies and positive externalities compared to intermediate and peripheral regions (Iammarino, Rodríguez-Pose, and Storper 2017).

In terms of potential effects in *host* regions, past offshoring processes show that firms justified their 'spatial fixes' on financial grounds, largely without considering local effects at former production sites. Local negative effects were (often) immediate large job losses (Coenen, Moodysson, and Martin 2014). Today, x-shoring has a more strategic justification (James, Mather, and Sheridan 2023), yet there is little to suggest that host regions are better equipped for structural change. Learning from OIRs, strong dependence, and industrial specialization did not prepare local actors to engage in regional development or entrepreneurial activities. This is especially true for company towns with asymmetric power relations, where local governments mainly tried to comply (Stihl 2024). Additionally, centralized states leave even less room for local agency (Görmar et al. 2022). Not only did OIR suffer from job loss, but they were also ill-equipped to deal with the new challenges. Local agency was dominated by reproductive agency and/or a lack of perceived agency: the inertia in informal institutions limited the

transformative capacity. This is a risk for host regions in x-shoring processes. However, the jobs lossed could be hazardous jobs in leading to a less harmful working environment for those employed and x-shoring does not necessarily mean that all corporate activities are brought home. Firms may choose to keep some activities while relocating others (Baraldi et al. 2018). If a host region completely loses its international firms, this may lead to reduced international participation, including knowledge spillovers, innovation, and development capabilities. The void created by the existing non-local actors may be filled by foreign direct investments from another country. For example, China is expanding its investments in several African countries (Kalvelage and Tups 2024).

In the *long-term*, these regions may become host regions for new firms or new developments. However, if their development is similar to that of OIRs in the Global North, we may also increasingly see the rise of left-behind places in the Global South (Tups, Sakala, and Dannenberg 2023). Restructuring releases resources such as labor (with different skills and competencies) and infrastructure. For many OIRs, this triggered unemployment and out-migration from which several regions have never fully recovered. In terms of infrastructure, there are examples across Europe of old factory buildings being repurposed and transformed into schools, cultural centers or science parks. Considering OIRs, these developments are often preceded by long periods in which these buildings deteriorate and become local landmarks of a failed past (Stihl 2024). However, there are also cases were regions managed to transform and avoid long-term decline. Hence, the development of host regions may develop differently. X-shoring processes will free up resources that local and national actors can reuse if they have the skills and agency to do so. This allows host countries to build their own new (green) industries, as is currently happening in Indonesia, where the president lobbys for battery factories (Cabinet Secretariat of the Republic of Indonesia 2023). As OIRs show, it can be difficult for regions and regional economies to transform, with the risk of increasing regional inequalities (Iammarino,

Rodríguez-Pose, and Storper 2017) and discontent (Rodríguez-Pose 2018). Transformation can take time (Stihl 2022), yet host regions can learn from OIR: there are opportunities for local actors to shape long-term development.

4.2 Local socio-environmental effects

When considering the *short-term* socio-environmental dimension of x-shoring in *home* countries, the building of new factories, sourcing of minerals, or building of circular facilities has effects on local ecosystems and people. Various cases in the EJ Atlas (Temper et al. 2018) document these (see, Table 1, Annex 1). For example, conflicts between local communities and firms due to intensification of (bio-based) resource extraction (e.g., cutting of forest, intensified agriculture, new mining) or the contamination of local ecosystems by production facilities (e.g., Friedrich et al. 2023). Recent examples of the construction of Tesla battery factory in the agglomeration of Berlin document the plausibility of these effects and related conflict between local communities, environmental movements, and Tesla (Deutschlandfunk 2024). Additionally, the building of novel circular facilities, such as for the recycling of batteries, may bring conflict between local communities and firms. Similar issues are attributed to the x-shoring of mining. Here, one can expect new or intensified conflicts over land use in home regions[4]. For example, land conflicts in northern Sweden between mining companies, municipalities, the state, and the indigenous group Sami, who have usufructuary rights to land, important for their livelihoods and culture (Stihl 2022). While economic activity always has effects on ecosystems, x-shoring is expected to lead to a better local environmental performance of firms' production (e.g., local emissions such as NO_2, availability of green energy, transport to markets) amongst others due to stricter environmental legislation in home countries (Di Stefano et al. 2023). In addition, x-shoring can be fueled by considerations regarding circular

[4] We consider land use conflicts to be both socio-economic and socio-environmental. They are placed in this section, but should be seen as related to both dimensions of impacts, as they are also linked to issues of socio-economic development and prosperity.

opportunities for reduced material input in production processes, and therefore create short-term opportunities for material reuse and recovery (e.g., reduce the generation of local waste and emissions). However, side streams and input materials need to be adequately governed to ensure that effects on ecosystems and residents are reduced.

These short-term effects may venture into *long-term* effects. For example, the media still document local actors discovering new environmental problems related to (past) industries and struggling to find a responsible party to finance the cleanup of production sites (e.g., Keilman 2023 for the Belgian case of PFAS). Clean-up is not only costly but also time-consuming. For example, the management of mine water after mine closure can span generations, as can other spatial transformations associated with mining (resettlement, new infrastructure). Over time, however, the short-term effects associated with circular opportunities related to x-shoring may increase, leading to improved environmental performance at home sites and reduced local effects on biodiversity. In particular, reduced geographical proximity between factories may stimulate the development of 4R innovations. These arguably have the potential to reduce local environmental impacts, such as waste streams (product packaging, production waste), and the reuse of products or recovery of minerals both have the potential to improve local environmental performance. The demand for green energy may drive an increased supply of green energy, yet also risks leading to competition. Many open questions remain regarding the feasibility of these effects and the potential of circular processes in general (e.g., Korhonen, Honkasalo, and Seppälä 2018).

Considering socio-environmental effects in the *host* country*,* there is a risk of the prevailing of local negative socio-environmental effects, since studies on OIR show local communities being left with environmental waste and pollution after firm exits (Coenen, Moodysson, and Martin 2014). Hence, negative socio-environmental effects remain, despite firms leaving these places. In general, it may also take time for ecosystems to recover from previous contaminations. Yet,

if production facilities are left and/or mining is reduced, this may lead to (immediate) reduced emissions of different kinds. Consequently, the effects on ecosystems and people related to these facilities may not be worsened and reduce the potential for conflicts between local communities, environmental NGOs, and firms (that are documented in Temper et al. 2018; EJAtlas 2024). However, this only holds if production facilities are not overtaken by new actors. Then, potential new conflicts may arise if new firms don't care for the well-being of local communities and ecosystems.

In a *long-term* perspective on host countries, spatial transformations related to mining and large-scale production facilities and their effects on local ecosystems will prevail long after x-shoring. Here, similar effects to those outlined among home countries are plausible. Depending on how regions recover from firms leaving their territory and how they are replaced with new firms, the short-term negative effects discussed above may venture into more long-term effects. This may particularly relate to the continued extraction of minerals.

4.3 Global effects

As the last two sections have shown, there are a variety of plausible local effects of x-shoring. On a global scale, these will mainly bring long-term effects, since a considerable amount of manufacturing and sourcing needs to be x-shored before socio-economic effects are visible at this scale. Yet, if jobs are moved from places with more relaxed to stricter environmental and social legislation, this suggests that these jobs will bring a reduction in harmful working conditions overall. The international division of labor may change, bringing manufacturing jobs back to home countries, yet may also drive job upgrading driven by more knowledge-intensive activities. The stricter environmental legislation in home countries, higher labor, and production costs may increase prices overall. Since GPNs have been organized as efficiently as possible (cf. cost-capability ratio, see Yeung and Coe 2014), x-shoring and related cost increases can create short-term tensions (increased costs for green transitions), yet long-term, this may be

alleviated through innovation capabilities and governance. If host regions begin to couple with new 'home' countries, such as China (Kalvelage and Tups 2024), this may imply a long-term shift in the geopolitical landscape as new firms and nations reap the rewards of manufacturing in host countries by exploiting their low social and environmental standards and labor cost. Either way, x-shoring can lead to new or renewed regional production clusters (Butollo et al. 2024), potentially leading to innovation capabilities for the CE.

In terms of socio-environmental impacts at a global scale, the potential for regionalization of resource flows due to reduced geographical distance and increased circularity opportunities may lead to a net improvement in the environmental performance of x-shored industries, particularly related to reduced CO_2 emissions due to reduced distance to market policy instruments in home countries and regions that affect these (e.g., emission trading schemes and carbon border adjustment mechanism in the EU). Long-term, this may even be enhanced, but also brings risk of 'environmental problem shifting' (van den Bergh et al. 2015) of issues related to one planetary boundary (e.g., CO_2) to another (e.g., land use), or from one location to another (e.g., if fossil inputs/energy are replaced by renewable inputs/energy driven by environmental legislation in home countries). In addition, local impacts, as described in the previous section, are linked to global socio-environmental issues. For example, local deforestation to make way for new production facilities and infrastructure is also linked to global land use issues and carbon emissions and sinks. However, these impacts are difficult to map effectively and depend on how firms operate (whether they take environmental responsibility or operate on the margins of legislation) and largely on how they are governed (Österblom et al. 2022). Consequently, governance at multiple levels, i.e., in home and host countries, by lead firms and other actors, play a critical role in shaping global impacts. For example, if home countries intend to combat climate change, they also need to consider the impacts on host countries and the interdependencies involved. Consequently, the impact of x-shoring needs to be assessed in

relation to other forms of change (e.g., new environmental legislation in host countries based on institutional work) and considered concerning the intention of policy instruments.

Table 1: Anticipation of plausible socio-economic and socio-environmental impacts of x-shoring across space and time

X-Shoring		**Socio-economic**		**Socio-environmental**	
		Short-term	**Long-term**	**Short-term**	**Long-term**
Local	**Home**	- Creation of new jobs, whereof half in low wage and labor-intensive jobs - Potential new labor competition - New circular opportunities (e.g., innovation, recycling of materials) - Socio-cultural effects related to socio-environmental conflicts surrounding land use (identities, liveliehoods, etc.)	- Value chains stability and technological sovereignty - Increasing no. of job within CE - New knowledge spillovers & innovation capabilities spurring (new) regional development paths	- New conflicts due to new/intensification of resource extraction - Risk of new conflicts due to new production facilities (e.g., contamination) - Better environmental performance of production and extraction facilities due to higher standards - New or intensified conflicts concerning land use, especially with indigenous groups	- Potential for long-lasting biodiversity effects at new sites of sourcing (extraction) and production (contamination) - Spatial transformations (e.g., mines, resettlements, intensified agriculture, new infrastructure, etc.) - Local environmental benefits through increasing opportunities for circular material flows
	Host	- Job loss in x-shored industries - Resources (labor and infrastructure) set free to be reused. - Potential couplings with new investors and new dependencies - Loss of (international) knowledge spillovers, innovation & development capabilities related to exiting firms.	- Potential growth of new 'left behind regions' - Reduced dependencies may open possibilities for new developments - Opportunities for reusing of buildings and infrastructure - Difficulties with diversifying due to former path dependencies	- Potentially reduced extraction of materials and related conflicts - Potentially reduced environmental issues and biodiversity effects - Potentially new conflicts with novel actors (overtaking sourcing and production)	- Long lasting socio-environmental effects of former mining and production areas - New industry development and/or replacement industries with potentially new environmental issues
Global		- Overall, potentially less harmful working conditions - restructuring of geographical distribution of jobs	- new regional production clusters - reduced dependency on home country and a shift in geo-political landscape - Shifting and reordering of dependencies and couplings	- Positive net environmental effects through regionalization of resource flows	- Positive net environmental effects - Risk of 'environmental problem shifting' from one aspect to another. - Local socio-environmental issues are linked to global issues -

5 Discussion

Spatial economic restructuring in the context of circular transitions in GPNs is often welcomed, while its socio-economic and socio-environmental effects across space,scale, and time are still rather unexplored. In general, however, spatial economic restructurings create (new) winners and losers (Bair and Werner 2011), couple, recouple, and decouple regions in and from global economic processes (MacKinnon 2011), and thus raise questions of justice and responsibility. To more thoroughly explore the geography of plausible consequences of x-shoring, and to inform the governance of a just and responsible CE, we have outlined a holistic framework for anticipating socio-economic and socio-environmental outcomes across space, scale, and time. In doing so, we pay attention to issues of multi-scalarity, multiple geographies, and temporality. Since circular transitions and related x-shoring activities are still largely in their infancy, and many empirical effects are not yet discernible, we have based our initial assessment of plausible effects on insights from OIR and environmental justice cases (Temper et al. 2018; EJAtlas 2024). This is a first, and illustrative, anticipation of plausible effects, trade-offs, and externalities of x-shoring, and thus a geographical contribution to the emerging body of knowledge on just circular transitions.

Next, we discuss the complex and multifaceted effects of x-shoring (5.1), explore emerging research directions for the geography of circular transitions in GPNs (5.2), and reflect on the speculative nature of this research (5.3).

5.1 Governing the multifaceted effects of x-shoring

Our anticipatory mapping of plausible effects associated with x-shoring, based on our holistic framework, reveals the multi-dimensional nature of these processes and their socio-economic and socio-environmental effects across space, scale, and time. During the mapping process, we realized that it is precisely the multi-dimensionality of these activities, their context and industry

specificity, that creates ambivalence and paradoxes across spaces and time. This is a complexity that is often (not intentionally) overlooked in the related CE literature. Our framework allows for navigating this complexity by presenting categories that can structure analyses. Based on these, we show that x-shoring may e.g., bring jobs to home countries, lead to a better overall environmental performance, while also resulting in job losses in host locations, yet may also reduce harmful working environments. On a global scale, improved environmental regulation in home regions can lead to socio-environmental gains. However, it is important to differentiate production processes from the sourcing of materials. The latter, whether in the former host or home countries, often leads to spatial transformations, resettlement of people, and local conflicts related to issues such as land use, health, and biodiversity. This is documented in the EJ Atlas (Temper et al. 2018) and in new sourcing activities in the global North (Stihl 2022). Often, these conflicts are related to minority or indigenous populations, raising questions of who bears the burden of restructuring. However, conflicts and negative effects can also relate to (novel or) x-shored production, as seen in media reports from the global North [5]. Yet, since not all parts of GPNs can be x-shored and spatially bound resources may continue to be extracted where they are available, an important question for future research is how the place-bound socio-environmental impacts of extraction can be more evenly distributed across space, as well as how firms can be held accountable for their socio-environmental effects across space and time (Österblom et al. 2022).

Consequently, governance and intentions behind the policies that drive x-shoring emerge as key aspects in this regard. Policymakers need to consider the ambivalences and potential consequences of x-shoring by assessing them against the intentionality of their policies (e.g., Inflation Reduction Act, Green New Deal, Carbon Border Adjustment Mechanism, etc.). While

[5] See, e.g., the new Tesla Gigafactory in Grünheide (Deutschlandfunk 2024; for English, see Paul 2024), close to Berlin or battery recycling factories in Poland (Annex 1).

it may be difficult to find decisions that are good *per se*, our framework can help evaluate x-shoring activities *vis-à-vis* other options, such as (state-led institutional work for) improved environmental regulation in host countries, to find ways with moderate socio-economic and socio-environmental effects across geographies. Temporality is also relevant in this regard: Short-term and long-term effects should not be seen as binary classifications, but rather as a sliding scale of time, with short-term effects venturing into long-term consequences. For example, an immediate change in the number of jobs may have long-term effects on the employment or structural conditions of a region. A short-term land conflict can lead to long-term judicial proceedings. Short-term reshoring of manufacturing may create long-term opportunities for circular innovation due to reduced distance.

All the aspects of x-shoring described above may be thought of as 'wicked problems' (Rittel and Webber 1973), characterized by uncertainty, complexity, and contestation across space and time. Our framework allows to think about the geographical dimensions of x-shoring and anticipate plausible effects. Therefore, it can inform governance in navigating such 'wicked problems' by presenting an approach through which to assess plausible effects, thereby rejecting reductionist and one-sided approaches that risk neglecting dimensions of these restructurings. Thus, we consider our framework well-equipped for use in subsequent research and policymaking.

5.2 Towards just circular transitions in GPNs: emerging research directions

We mapped plausible futures based on insights from OIRs and the EJ Atlas, because of a lack of empirical research on these ongoing phenomena. Circular transitions (and x-shoring) in GPNs are rather novel developments and may consequently transcend existing knowledge on historical cases, underlining the relevance of empirical research studying these phenomena. To provide guidance and inspiration for future research, we outline a *non-exhaustive* list of promising research avenues for geographical scholarship on a global CE.

(1) *Understanding the geography of circular transitions in GPNs.* Scholarship on the CE has rarely addressed the global, often multi-scalar nature of change[6]. However, CE processes, like other economic processes, are embedded or coupled in GPNs. We therefore see a need to more explicitly address the global and multi-scalar nature of circular transitions. This can relate to the geography of transition mechanisms, actors, and innovation, how circular transitions reconfigure both existing (regional) innovation systems and GPNs, and how tensions between linear models of production and more circular approaches unfold in GPNs and regional economies.

(2) *Better understanding and recognizing the effects of circular economic transitions beyond benefits across scale and time.* Due to the lack of scholarship on the global and multi-scalar aspects of circular transitions, we have based our illustration on historical cases. Yet, as circular transitions in the global economy unfold, so must geographical scholarship analyze the multi-scalar nature of these processes and their (distributive justice) implications across space and time. We particularly encourage research that focuses on a better understanding of the (negative) effects of circular transitions in GPNs on different actors, places, scales, and environments, linking it to existing debates on uneven development, left-behind places, and environmental justice.

(3) *The geography of 'just' circular transition.* While the negative effects of circular transitions are relevant to study, the production of winners and losers is in the very nature of restructurings. We therefore see great potential for CE scholarship to engage with the geography of justice in the processes of transitions. In doing so, we echo the argument of others (e.g., Purvis, Celebi, and Pansera 2023) to take up ideas from RRI (Owen, Macnaghten, and Stilgoe 2012; Stilgoe, Owen, and Macnaghten 2013) as a means of making these processes more just and responsible. It is an open question how we can design

[6] Although some have begun to discuss this topic, see, Hofstetter et al. (2021); Schroeder et al. (2018).

such processes in a global setting. We encourage scholars to work on these questions to find ways to navigate different dimensions of justice and responsibility. Such work will be particularly relevant for informing the governance of circular transitions in the global economy.

(4) *Finally, research needs to better link to (and inform) policy.* The future is characterized by known unknowns and unknown unknowns. Learning from past processes to anticipate the future is essential to better embrace the risks and uncertainties of spatial restructurings. Although OIRs experienced large offshoring decades ago, we still read in the news about local policymakers in, more or less specialized regions in the Global North, being surprised over dominating firms leaving (Kirkebæk-Johansson 2024). We suggest that local and regional policymakers around the world need to embrace risk and uncertainty and start working more proactively on topics such as local empowerment, local entrepreneurship, and economic diversification. We encourage scholars to provide adapted policy outlets that transport complexity and link to topics of local agency to provide empirical examples of how other regions have navigated similar historical situations (Grillitsch and Sotarauta 2020).

5.3 Reflections and limitations

We have focused on x-shoring as a unidirectional process from host to home or friends' countries to simplify our analysis. In reality, however, these processes, like any other process, are more complex, vary with geography and industries, and can move in different directions (Kalvelage and Tups 2024). We note that our framework does not currently account for these processes but can be used to analyze these by changing the categories of home and host. Furthermore, because we have mapped plausible effects of x-shoring activities in a speculative approach, our mapping is subject to uncertainties that we wish to acknowledge. Consequently, our results should be treated as *potential* effects, informed by empirical evidence on historical

cases of *similar* phenomena. This also means that we have mapped insights into these processes that describe potential trade-offs and effects. However, given the immense number of cases in the EJ Atlas and the OIR literature, this can only be seen as indicative. Furthermore, in contrast to the idea of anticipation in RRI, which is based on anticipation exercises involving a wide range of actors, we have built our approach on existing knowledge about OIR and the EJ Atlas. In doing so, we were able to consider the multi-scalar effects of these processes, as engaging actors across space and time is challenging. While this should be a principle for future approaches, we argue that speculative approaches, such as ours, have the potential to open discussions on issues that might otherwise be overlooked. In our case, we want to open a discussion on the geography of circular transitions in GPNs. We encourage future research to complement our mapping, based on in-depth case studies and transdisciplinary anticipatory exercises involving a wide range of actors across space and scale.

6 Conclusions

In this paper, we provide a framework for analyzing the socio-economic and socio-environmental consequences of x-shoring in their multi-scalarity across space and time. Our interdisciplinary perspective integrates contributions from economic geography, political ecology, and social-ecological systems for a holistic approach to the geography of x-shoring. Such an approach, we argue, can better account for the multi-dimensionality and complexity of such processes. It is therefore well suited to stimulate new research on the multiple impacts of x-shoring and the circular economy. It may also be relevant for policymakers at different levels and for firms to prepare for and rethink the consequences of such processes, and to take stewardship of the local environment and communities beyond considering job losses and gains in the context of circular transitions. Anticipating plausible outcomes of x-shoring has resulted in a complex picture of both positive and negative effects in different places, scales and times. Consequently, given the multiplicity of effects mentioned above, x-shoring might be thought of

as a wicked problem with effects in multiple places beyond our theories, knowledge, and imagination. While our fluoroscopy has not been able to map all foreseeable impacts and effects, it does bring us closer to understanding what can be expected as x-shoring increases, affecting GPNs, the geography of production, and whether it is pursued for the sake of more secure value chains, increased economic growth, or sustainable development. We hope this will spark discussions about the geography of responsible circular transitions in the global economy at large and empower local actors in this restructuring.

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Annex 1: Anticipation of plausible socio-economic and socio-environmental impacts of x-shoring across space and time. Based on the findings on spatial restructuring processes in old industrial regions and socio-environmental conflicts documented in the Environmental Justice Atlas (EJ Atlas 2024), the table outlines plausible impacts of x-shoring. It should be noted that the table provides only examples of effects to illustrate the need for and guidance on such analysis. The cases referenced in the EJ Atlas often describe specific linkages between different domains and parallel effects in more detail.

X-Shoring		**Socio-economic**		**Socio-environmental**	
		Short-term	**Long-term**	**Short-term**	**Long-term**
Local	**Home**	- Local (quantitative) creation of new jobs related to the circular economy (e.g., estimates by EU Commission 2020) - Whereof ca. 50% Jobs in low wage and labor-intensive jobs (Llorente-González and Vence 2020) - Circular opportunities (e.g., circular innovation, recycling of materials) through regionalization and geographical proximity (e.g., Di Stefano et al. 2023) - New or intensified socio-cultural conflicts concerning land use, especially with indigenous groups (identities, livelihoods)	- Value chains stability and technological sovereignty (e.g., EuropeanParliament et al. 2021) - Increasing job needs of circular economy and x-shoring might spur potential competition between industries, firms, and regions what regards labor (in absolute terms) - New investments and industry locations may translate in knowledge spillovers & innovation capabilities spurring (new) regional development paths	- New socio-ecological conflicts due to intensification of renewable resource extraction (e.g., bioeconomy, see Friedrich et al. 2023) or the x-shoring of mineral sourcing[c] - Risk of new conflicts (related to contamination etc.) due to new production (and recycling) facilities (analogue to conflicts in former host countries[d]) - Better environmental performance of production and extraction facilities (higher standards in home countries, see Di Stefano et al. 2023) - New or intensified land use conflicts, especially with indigenous groups	- Potential for long-lasting biodiversity effects and loss at new sites of sourcing (extraction) and production (contamination)[g] - Spatial transformations (e.g., mines, resettlements, intensified agriculture, infrastructure building, etc.)[h] - Local environmental benefits through increasing opportunities for circular material flows (Di Stefano et al. 2023) and less extraction and waste

	Host	- Potential couplings with new partners (cases from African countries and China) and new dependencies - Resources such as labor and infrastructure set free to be used - Job loss (quantitatively) due to x-shoring like outsourcing related effects in former OIR - Job loss (qualitatively), e.g., jobs with bad working conditions such as in mining and mineral extraction[a] if companies are not just replaced with new ones - Loss of (international) knowledge spillovers, innovation & development capabilities related to these firms etc.	- Loss of sourcing and production facilities may translate these regions into 'left behind regions' (see historical cases of OIR) - Opportunities for reusing of buildings and infrastructure/ may also remain landmarks - Reduced dependencies may open possibilities for new developments - Difficult to diversify because of former path dependencies - Long lasting financing of socio-environmental issues of mining etc.[b]	- Potential for reduced extraction of materials, reduced conflicts between different actors and communities[e] - Potential for reduced environmental issues and biodiversity effects related to production facilities[f] - Potential for new conflicts if novel actors overtake existing sourcing areas and production facilities	- Long lasting socio-environmental issues of former mining and production may persist - New industry development and/or replacements of x-shored industries: potentially new environmental issues (potentially less regulated and/or informal)
Global		- Overall, potentially less harmful working conditions[a] - restructuring of geographical distribution of jobs (high value / low skilled jobs, see Barrie and Schröder 2021)	- reduced 'western' hegemony and a shift in geo-political landscape, see for example China's geopolitically induced friendshoring in Tanzania and along the Belt and Road initiative (Kalvelage and Tups 2024; Carmody and Murphy 2022) - new regional production clusters (Butollo et al. 2024) - Shifting and reordering of dependencies and couplings (e.g., Western countries – Global South vs. China – Global South)	- Positive net environmental effects through regionalization of resource flows (relevant for planetary boundaries), less trade-related CO_2-emissions, circular opportunities, and stricter environmental legislation in home countries	- Positive net environmental effects - Risk of 'environmental problem shifting' (van den Bergh et al. 2015) from one environmental aspect to another or from one location to another - Local socio-environmental issues are linked to global issues -

[a] The EJ Atlas documents various cases of bad (unethical) working conditions in mineral extraction, see for example case 6626. These might be reduced when sourcing is x-shored and no new companies take over these facilities and locations.

[b] The management of mine water (after mines are closed and firms have left) can span generations, see for example cases of the Ruhr-Region in Germany.

[c] The EJ Atlas documents cases in "home" countries in which the extraction of minerals relates to socio-environmental struggles, for example case number 6427, in which the Sami population questions the legitimacy of quartz mining at the Norwegian/Swedish border.

[d] The EJ Atlas documents socio-environmental struggles related to the sourcing and production of materials. What regards the establishing of new recycling facilities, see for example conflict ID 5792, in which a South Korean company dropped the initial plans to build a battery recycling factory in Poland because of the protest from the local community. See also conflict ID 5026.

[e] The EJ Atlas documents conflicts that surround the extraction of materials. See for example case number 5620. Through x-shoring these activities, there is the potential for solving these struggles if no new company overtakes these sourcing areas.

[f] The EJ Atlas documents conflicts that surround the production of specific goods or economic development in a specific region. See for example case number 5006 on one of the 'sacrifice zones' in Chile related to aspects such as s lack of health and increased cancer risk. Some of these effects may prolong in former production locations (see also OIR cases), while some of these issues may also 'travel' to novel future production areas.

[g] The EJ Atlas documents cases in which the extraction of materials and the production of goods related to long lasting effects on local biodiversity. We consider this a risk if new sourcing and production sites are not adequately governed. See for example case number 1589 that particularly outlines the risk of long-lasting effects.

[h] Thee EJ Atlas documents cases in which the sourcing or materials is related to spatial transformations, for example in terms of relocating people. See for example case number 306, which documents the spatial transformations and relocations of people related to lignite mining in Lusatia, Germany.