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Review

Inequality determined social outcomes of low-carbon transition policies: A conceptual meta-review of justice impacts

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ABSTRACT

Inequality and climate change represent two key challenges in modern societies across the world. In this paper, we provide a critical engagement with the literature that treats aggravated social and economic inequalities as (potential) negative outcomes of climate and low-carbon transition policies that aim to achieve carbon emission reductions in energy and transport sectors. We introduce a conceptual meta-review that systematises but also departs from three existing literature reviews by challenging the prevailing treatment of inequalities as ex-post negative outcomes. Instead, we draw on literature that treats multifaceted inequalities as systemic occurrences that are rooted in socio-economic structures. Therefore, the conceptual meta-review exhibits an inequality filter which shapes the nature of policy costs, benefits and compliance. In other words, multifaceted inequalities are treated as ex-ante phenomena that interact with climate and low-carbon transition policies. This interaction then determines social outcomes in terms of energy access, health, employment, essential goods affordability and livelihoods. Each of these outcomes then feed back into the inequality filter where existing inequalities are either amplified or diminished. In order to examine the efficacy of our conceptual framework, we also provide a limited review of more recent literature that discusses the social outcomes of climate and low-carbon transition policies as well as measures to prevent negative social outcomes. Altogether, this paper suggests that the mitigation of systemic inequalities, rather than the prevention of aggravated inequalities, is necessary to avert the transmission from climate and low-carbon policies to negative social outcomes.

1. Introduction

The global aspiration to keep global temperature rises below 2, but preferably 1.5 degrees, calls for a profound transformation of prevailing socio-economic structures [1]. Over the past decades, scholarly literature has designated these necessary transformations as sustainability or low-carbon transitions [2–4]. In essence, these transitions aim to substitute carbon intensive energy resources and technologies for low-carbon variants. However, one of the key challenges related to low-carbon transition policies relates to their potential to induce social injustices. As such, civil society, activists, non-governmental organisations and scholars occupied with this challenge are demanding climate justice pathways and just transitions [5–12].

Against the backdrop of justice concerns, an increasing amount of scholarly literature is directed at a deeper understanding of low-carbon transition policies and their social outcomes. This paper addresses this topic by underlining three individual literature reviews on transition policies and social outcomes [13–15]. Because the concept of low-carbon transitions is relatively new, the policies considered in the literature reviews are referred to as environmental, climate or energy policies. In the remainder of this paper we refer to this set of policies as climate and low-carbon transition policies (C&LCTP). Each of the literature reviews address distinct social outcomes and when it comes to the analysis of transmission pathways (how C&LCTP policies result in social outcomes), the manifestation or exacerbation of economic and social inequalities (income, wealth, race, gender, etc.) are treated as potential social outcomes.

This paper challenges the *ex-post* consideration of inequalities and argues that transmission pathways are best understood through the treatment of inequalities as *ex-ante* instances inherent to socio-economic and political structures. In our opinion, this alternative treatment of inequalities amends the climate justice and the just transition discourses as well as the advocacy for policies that aim for inequality reduction rather than the mere prevention of increased inequality [16–19].

As such, the main contribution of this paper is a more complete examination of C&LCTP and how they relate to social outcomes through systemic economic and social inequalities. This examination ultimately takes the shape of a conceptual meta-review of the aforementioned

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literature reviews on the social outcomes of C&LCTP. This conceptual meta-review systematises C&LCTP, their interaction with inequalities, subsequent social outcomes and how they feed back into a potential amplification of the same inequalities. Prior to the introduction of the meta-review, Section 2 introduces the climate justice and just transition discourses and isolates their approach to inequalities. Section 3 introduces a systematisation of the literature reviews conducted by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15] and recasts their findings on transmission pathways according to the treatment of inequalities as *ex-ante* instances. In addition to this meta-review, Section 4 presents a limited literature review on more recent contributions that discuss the social outcomes of C&LCTP. We then redefine the transmission pathways identified in these contributions in accordance with the conceptual meta-review presented in Fig. 1. Section 4.2 also discusses recent contributions on policy measures that can prevent the manifestation of negative social outcomes. Section 5 highlights shortcomings and open questions. These concern the scope of C&LCTP, the relation between inequality reduction and carbon emissions and participatory and deliberative processes. We conclude the paper with a summary of our contribution and a short reiteration of the avenues which require further investigation.

2. Climate justice, just transitions and inequalities

Climate justice (CJ) and just transition (JT) discourses both share origins in the environmental justice discourse (EJ). While justice is a plural concept which varies across contexts, EJ typically treats injustices as "distributive inequity, lack of recognition, disenfranchisement and exclusion, the undermining of basic needs, capabilities and functioning of individuals and communities" ([20], p. 360) and in relation to environmental hazards and natural resources. Most scholars trace the beginning of EJ to the 1982 resistance against toxic waste disposal in Warren Country, North Carolina; a poor and majority African-American community (see e.g. [21–24]). Hence, environmental justice (EJ) is traditionally seen as a merger between civil rights movements and environmental groups in the USA.[1] By the late twentieth and twenty-first centuries, EJ was adopted by urban environmental groups, indigenous land movements and socio-economic justice movements that rejected the conception of the environment as wilderness and entirely void of race and class issues ([29], pp., 22, - 23, [30,31]. Indeed, EJ is known to incorporate traditional and structural inequalities such as class, gender, race and ethnicity in their analyses of wider environmental injustices ([32], p. 80).

In the Global North, the EJ discourse was predominantly preoccupied with a) marginalised communities that were disproportionately affected by environmental risks and b) advocacy for green spaces and parks ([20], p. 360). In the Global South, EJ has been associated with the various organisations and movements expressing resistance to the entanglement of capitalist accumulation and environmental degradation, e.g. deforestation in Brazil and hydrocarbon extraction in the Niger Delta [33].

CJ can be seen as the natural outgrowth of environmental justice in the face of increasing evidence for anthropogenic global warming and ultimately represents the solidification of climate change activism in the 1990s [20,34,35]. The concept was first introduced to the international political arena in the Bali Principles of Climate Justice defined by Global South and North actors at the 2002 United Nations World Summit on Sustainable Development in Johannesburg [36].

Early iterations of JT can be seen as a labour-oriented version of EJ adopted by trade unions who were concerned about the impact of environmental regulations and standards on jobs [37]. In the context of climate change, JT recognises trade-offs between competing needs, e.g. employment and access to energy vis-a-vis climate priorities [7]. According to McCauley & Heffron, JT then refers to "the development of principles, tools and agreements that ensure a fair and equitable transition for all individuals and communities" ([10], p. 2). Trade-unions and labour organisations following the JT discourse are joining conversations on climate change in order to promote the labour-friendly transformations of productive systems into low-carbon variants (Morena et al. in: Velicu & Barca [38]).

Before discussing the approach to inequalities in the CJ and JT discourses, a brief introduction to inequality is conducive. Inequality generally refers to the difference between individuals or social groups in terms of their command over resources and opportunities [39,40]. Many studies focus on differences in income and wealth, or economic inequality, since social well-being in capitalist societies is typically determined by one's purchasing power [41]. At the same time, the manifestation of economic inequality is tightly linked to both spatial inequalities across local, regional and international scales and social inequalities along the lines of class, gender, sexual orientation, race, ethnicity, religion and disabilities [42]. On the whole, inequality can be seen as a complex web of overlapping attributes which often mutually reinforce the unequal access to resources and opportunities.

Markkanen & Anger-Kraavi [13] point out that the incorporation of inequalities in the CJ discourse typically frames disparities in the command over resources and opportunities in terms of differences in the benefits and costs associated with climate change. Indeed, scholarly works in the field of CJ analysis often refer to "double or triple inequalities" [18,43–46] which politicise 1) who has historically benefited from greenhouse gas emissions and who should be responsible for its mitigation, 2) who holds the highest capacity to reduce emissions and adapt to extreme weather events and 3) who will suffer the highest losses and damages as the result of climate change impacts [47]. In the context of international climate agreements, it is often accentuated that the Global North is more 1) *responsible*, has the highest 2) *adaptation capacity* all whilst estimated to be less 3) *vulnerable* to climate change impacts compared to the Global South [48–54].

Other approaches in CJ analysis focus on more local scales, e.g. urban, community, household and individual levels, and highlight how income inequality and marginalisation determine disparities in *responsibility* [19], *vulnerability* and *adaptation capacity* [55–58]. In addition, these analyses reveal how increased *vulnerability* to and the lack of *adaptation capacities* vis-a-vis extreme weather events tend to exacerbate income inequalities and marginalisation [59–62].

Finally, there are CJ analyses that explicitly focus on attempts to increase *adaptation capacities* through the implementation of climate and low-carbon transition policies (C&LCTP) and for the purpose of achieving emission reductions [13–15]. The aim of these analyses is to accentuate the impact of C&LCTP on multifaceted and mutually reinforcing inequalities. Similar analyses are also apparent in the JT discourse which accentuates that a successful low-carbon transition must address concerns related to gender and racial equality, democratic participation, social justice [63] and between-country equality. Where the latter demands the recognition and inclusion of economies in the Global South [64–67].

The examination of multifaceted inequalities in relation to C&LCTP constitutes the main topic of this paper. Instead of merely providing a summary of the aforementioned contributions, this paper presents a critical engagement through the consultation of three literature reviews that address the social outcomes of C&LCTP. The contributions by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15] argue that C&LCTP represent a complex rearrangement of the social, political and economic spheres which in turn subjects said policies to co-impacts (positive or negative social outcomes). To increase public support, prevent regulation rollbacks and ultimately guarantee

[1] Other scholars indicate earlier instances of EJMs such as the United Farmworkers of America's resistance against community and worker exposure to pesticides in the late 1960s and 1970s [25,26] and the Italian experience with "class ecology" in relation to occupational health hazards in the 1970s [27,28].

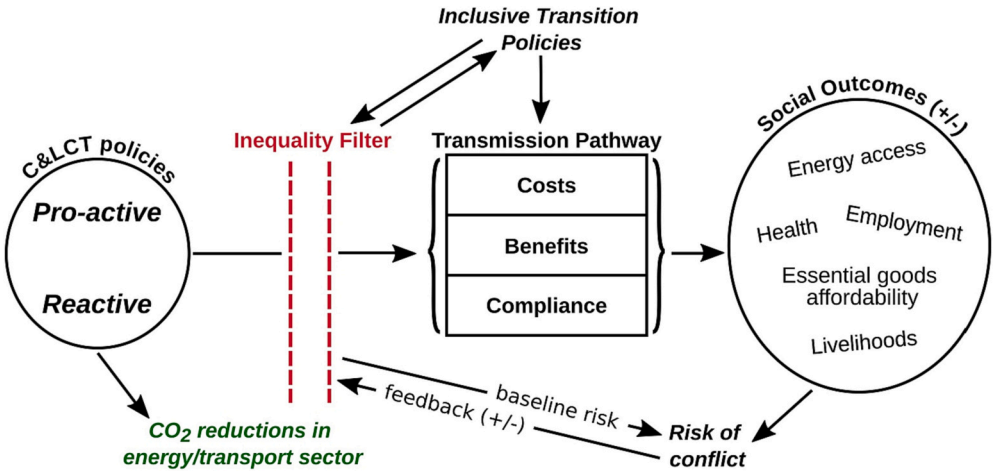

Fig. 1. Conceptual meta-review on the social outcomes of climate and low-carbon transition policies. C&LCT stands for Climate and Low-Carbon Transition. Source: Author's own elaboration.

the success of C&LCTP, it is therefore crucial to prevent negative social outcomes and foster positive social outcomes.

While each of the aforementioned literature reviews address a different set of social outcomes, their common characteristic lies with the treatment of inequalities as negative social outcomes. Put differently, inequalities enter the assessment of C&LCTP in an *ex-post* fashion even if they are present before C&LCTP are implemented or designed. Meanwhile, recent literature have increasingly shifted away from the treatment of inequalities as "unfortunate side circumstance(s) of capitalism" ([68], p.18, *(brackets added)*) and emphasises that economic and social inequalities are systemic and entrenched in socio-economic and political structures [42,69,70]. This paper follows this line of thought and argues that the analytical consideration of inequalities as an outcome of C&LCTP is limiting in two ways. First, it denies an assessment of the way in which systemic inequalities grant certain groups more or less privileged positions vis-a-vis specific policy proposals [61,71,72]. Second, it restricts policy design to the prevention of increased inequalities while abstaining from efforts that challenge the existing structures that perpetuate systemic inequalities [32,73].

Notwithstanding, the literature reviews by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15] offer valuable insights regarding the *transmission* of C&LCTP to a plurality of social outcomes. On the whole, this is done through the lens of various justice dimensions: 1) distributive justice, concerning the fair allocation of goods and resources benefits and costs, 2) procedural justice, concerning who takes what decisions and 3) recognition justice, concerning who is and who isn't valued [74–76]. In the following section we consolidate these literature reviews into a conceptual meta-review that offers an analytical alternative to the treatment of inequalities as negative social outcomes.

3. A conceptual meta-review of climate and low-carbon transition policies and their social outcomes

In this section we present a conceptual meta-review of the literature reviews conducted by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15]. Our systematic meta-review departs from an extraction of the following information from the literature reviews:

First, we systematise the transition characteristics discussed in the literature reviews. This encompasses 1) the specific field tackled by the respective C&LCTP, e.g. energy, agriculture, waste generation, biodiversity etc., 2) the types of C&LCTP considered and 3) the geographical area in which C&LCTP took place or are planned to take place. Then, we systematise social outcome characteristics by addressing the type of social outcomes and the transmission pathways discussed in the literature reviews. Transmission pathways is a concept we introduce to systematise how each of the literature reviews treats the specific way C&LCTP lead to social outcomes. Our redefinition of inequalities as *ex-ante* instances is established through the deliberation on transmission pathways. The following subsections examine each of the questions posed in Table 1 and relate the answers to the conceptual meta-review (Fig. 1) found at the end of Section 3.2.1.

3.1. Transition characteristics

We find that the literature reviews limit their assessment of C&LCTPs to the field occupied with decreasing the carbon intensity of energy and transport systems. Markkanen & Anger-Kraavi [13] divide C&LCTP into three distinct categories: a) those that aim to reduce energy consumption, b) those that aim to foster the deployment of renewable energy and c) those that aim to develop and preserve carbon sinks. On the other hand, García-García et al. [14] make a distinction between proactive policies, aimed at the low-carbon transformation of current socio-technical systems, and defensive/reactive policies, aimed at mitigating the effect of climate change through a direct reduction of carbon emissions. While Lamb et al. [15] do not explicitly categorise the policies they take into consideration, one can easily distinguish between those aimed at reducing carbon emissions (transport fuel taxes, energy and carbon taxes and energy retrofit subsidies) and those aimed at increasing the presence of renewable energy alternatives in current socio-technical systems (renewable energy subsidies, feed-in tariffs and the direct procurement of renewable energy). On the left-side of Fig. 1, we present a simplified overview of transition policy types by following García-García et al. [14] in their distinction between proactive and reactive policies. In terms of the geographical area, each of the literature reviews attempts to provide a global assessment of C&LCTP and social outcomes,

Table 1
Information extracted from literature reviews.

	Question	Element
Transition characteristics	Which field do C&LCTP address?	Transition field
	Which types of C&LCTP are considered?	Policy type
	Where have/will C&LCTP been/be implemented?	Geographical area
Social outcome characteristics	Which social outcomes have been identified?	Social outcome
	How did/will C&LCTP impact social outcome(s)?	Transmission pathways

but ultimately face an over-representation of case studies in North America and Europe. This also means that our conceptual meta-review is less likely to be applicable to countries in the Global South. Section 3.2.1, which discusses transmission pathways, further elaborates on the C&LCTP addressed in the literature reviews.

3.2. Social outcome characteristics

When it comes to social outcome characteristics we find that Markkanen & Anger-Kraavi [13] and Lamb et al. [15] evaluate different C&LCTP in terms of multi-dimensional social outcomes (e.g. poverty and livelihood impacts, energy affordability/access and gender inequality), while García-García et al. [14] limit their discussion of C&LCTP to social outcomes that are strictly related to income distribution and employment outcomes. The literature review by Markkanen & Anger-Kraavi [13] is unique in that it discusses the impact of C&LCTP on health inequality e.g. in terms of air pollution, air quality, access to affordable heating/cooling services but also mental and physical health. The explicit focus of García-García et al. [14] on employment effects discloses how these effects are related to labour mobility, the ability to move from one occupation to another, and skills. Since this paper challenges the treatment of inequalities in the literature reviews, the right-side of Fig. 1 only shows "non-inequality" social outcomes which are not mutually exclusive: health, employment, livelihoods, energy access, and essential goods and services affordability. The alternative we propose is elaborated upon in the subsection below on transmission pathways.

3.2.1. Transmission pathways

The diversity in terms of C&LCTP and social outcomes results in distinct, though not incompatible, inferences regarding the transmission pathways from policy to outcome. While some of the contributions discuss transmission pathways by highlighting the factors that lead to negative social outcomes, others highlight factors that ensure the prevention of negative social outcomes. Fig. 1 introduces a conceptual summary and re-interpretation of the transmission pathways identified in the literature reviews.

Our re-interpretation suggests that each policy type passes through a filter of interrelated inequalities. As mentioned in Section 2, this is an important deviation from existing contributions. Instead of strictly referring to inequalities as negative social outcomes of C&LCTP, we argue that C&LCTP pass through an inequality filter and that the existing inequalities therein shape the nature of policy costs, policy benefits and policy compliance. The transmission from policies to social outcomes through policy costs, benefits and compliance is borrowed from Lamb et al. [15] and we present the transmission pathways found in Markkanen & Anger-Kraavi [13] and García-García et al. [14] according to this classification. It is important to clarify the distinction between policy costs and policy compliance since complying to a policy bears a cost in and of itself. Transmission pathways associated with policy costs refer to the costs of *implementing* a policy while transmission pathways associated with policy compliance refer to the costs of complying with or *adhering to* a specific policy. Furthermore, costs and benefits are not necessarily monetary and as single policy type can be subject to more than one transmission type.

In sum, Fig. 1 frames social outcomes as the result of an "inequality determined" distribution of costs, benefits and compliance. In turn, this distribution potentially reinforces or diminishes the existing inequalities in the same filter. The following paragraphs are dedicated to a discussion of the transmission pathways identified in the literature reviews.

Policy costs transmission pathways. Policy costs refer to the costs associated with the implementation of a C&LCTP. When it comes to the associated transmission pathways, feed-in-tariffs discussed by Markkanen & Anger-Kraavi ([13], p. 833) and Lamb et al. ([15], p. 14) offer a straightforward example. Feed-in-tariffs aim to incentivise the generation of renewable energy (proactive policy) by offering renewable energy producers a higher selling price which is funded through a surcharge on electricity prices. Both of the aforementioned literature reviews highlight that increased energy costs represent a higher share in the budget of low-income households and therefore treat income inequality as a social outcome. Our conceptual meta-review reconstructs this statement by postulating that existing income and wealth inequalities shape the impact of increased energy costs on energy affordability.[2] Moreover, income and wealth inequalities tend to be gendered and racialised; women and minority groups are often over-represented in low-income households. Hence, the interaction between feed-in-tariffs and existing inequalities shape the distribution of policy costs which can lead to decreased energy affordability as a social outcome. Similar transmission pathways are identified for renewable energy procurement obligations if financed through an increase in electricity prices ([15], p. 18). Another policy type discussed in relation to policy cost transmission pathways is the large-scale deployment of renewable energy projects (proactive policy). The contributions highlight case studies that reveal that the top-down imposition of renewable energy infrastructures has led to the privatisation of land which was previously held in communal ownership ([13,15], pp., 19-20). This exposes that C&LCTP are implemented without consideration for indigenous peoples which have built their livelihoods on the basis of various land resources. In this case, one can argue that policy costs are filtered by interrelated race, ethnic and wealth inequalities that shape the legal ownership of land. The policy costs associated with large-scale renewable energy projects are subsequently borne by those who are dispossessed, ultimately resulting in a negative impact on land-based livelihoods. Similar transmission pathways can be derived from Markkanen & Anger-Kraavi's [13] discussion of land-use changes in relation to bio-fuel production and carbon sink preservation through forestry projects, e.g. REDD, REDD+ and PES ([13], p. 834). In addition to land-ownership transmission pathways, policy costs associated with the production of biofuels can also take the shape of increased food prices and decreased food security where existing inequalities determine which groups experience a decrease in the affordability of essential goods and services as a social outcome.

The literature reviews also designate job loss/unemployment as a social outcome associated with the unequal distribution of policy costs accompanying the closure of hydrocarbon plants and mining facilities (reactive policy). Since this policy type bears a cost for hydrocarbon sector workers as well as workers in the food, service and leisure industries of a hydrocarbon intensive regions or towns, the absence of compensation, diversification plans and/or substitution of hydrocarbon plants with renewable energy plants is likely to increase income inequality ([13], p. 833). On the other hand, some of the studies reviewed by García-García et al. [14] estimate the international, national and regional employment effects of hydrocarbon plant closures in combination with low-carbon industry expansion and find that the positive impact of the latter is relatively small due to limiting factors such as labour skills and mobility ([14], pp., 8-10). The transmission pathway discussed by Lamb et al. [15] is focused on the consumer side rather than the producer side. They relate the closure of hydrocarbon plants and mining facilities to energy affordability as a social outcome for households who are unable to switch to other energy sources ([15], p. 21). Our reinterpretation retains employment as a social outcome of hydrocarbon closures but treats income inequality as an *ex-ante* phenomenon which is closely related to *ex-ante* inequalities in terms of labour skills and mobility. Low-skilled and less mobile hydrocarbon workers will bear the heavier cost of hydrocarbon closures since they are likely to face longer periods of unemployment. In addition, *ex-ante* income inequality determines the extent to which alternative energy sources are affordable.

[2] Energy affordability is represented in Figure 1 as "Essential goods affordability".

Finally, Markkanen-Kaarvi et al. address the source of funding for C&LCTP that facilitate investments in low-carbon sectors (proactive policies), e.g. energy generation and the electrification of public transport. If these investments are public and result in a decrease of other social expenditures, the authors point out an increase of income inequality as access to essential and affordable public services is curtailed ([13], p. 833/837). Again, our conceptual framework suggests a treatment of income inequality as an *ex-ante* instance that ensures unequal transmission of policy costs to people who rely on social benefits and services. In this case, the social outcome can take various dimensions, e.g. a reduction in unemployment benefits may have a negative impact on livelihoods, health, but also on the affordability of essential goods and services.

Policy benefits transmission pathways. The transmission pathways discussed in this paragraph regard the distribution of benefits through a specific C&LCTP. For example, Markkanen & Anger-Kraavi [13] argue that small-scale renewable energy projects (proactive policies) that ensure equitable access to new technologies can lead to increased energy affordability/access as a social outcome which in turn diminishes income inequality ([13], p. 833). The literature review by Lamb et al. [15] extends this argument with a focus on renewable energy subsidies (proactive policies) and highlights that income inequality reduction depends on whether the aim is to increase electrification or to foster the substitution away from conventional energy sources. The reviewed studies indicate that the former is characteristic of rural regions and developing countries and indeed more often associated with increased energy affordability/access. Substitution away from conventional energy sources is characteristic in high-income countries and often disproportionally benefits wealthier households due to the fact that private investments are often necessary to guarantee participation in renewable energy subsidy schemes ([15], pp., 12-13). Markkanen & Anger-Kraavi [13] also highlight how the incorporation of gender concerns in small-scale renewable projects can foster a synergy between increased energy affordability/access and the advancement of gender equality ([13], p. 836). On the other hand, some of the studies reviewed by Lamb et al. [15] reveal that the ownership of small-scale renewable energy installations was heavily biased towards men ([15], p. 18).

Biofuel production and energy retrofit programs/subsidies (proactive policies) are discussed in a similar way; the nature of transmission pathways from policy benefits in terms of increased energy affordability/access and subsequent inequality reduction as a social outcome depends on whether the programs reach smallholder farmers, women and low-income households equally ([13], p. 833/836, [15], p. 14).

Energy retrofit programs and renewable energy projects can be seen as elements of broader investments in the low-carbon sector (proactive policies) which are subject to policy benefits that generate employment as a social outcome. Like the policy costs related to the closure of hydrocarbon plants and mining facilities, the pass-over of policy benefits in terms of employment depends on labour skills and mobility ([14], pp., 8-10). One of the studies reviewed by García-García et al. [14] highlights how younger individuals with lower levels of qualification and labour force participation gain less employment opportunities from wind-energy deployment ([14], p. 12). One can also imagine a scenario which benefits younger workers over older workers who are less physically mobile and therefore unable to e.g. travel 120 km away from their home-towns to work in the low-carbon sector. Furthermore, in the absence of programs dedicated to up-skilling or re-skilling, it is evident that green sector jobs will only benefit the fraction of workers with the relevant skill-set. Meanwhile, the endowment of mobility (physical and labour related) and skills is gendered; women are still under-represented in high-skill jobs and are less able to travel long distances to work due to their involvement in unpaid domestic work.

Evidently, the closure of hydrocarbon plants and mining facilities but also the electrification of transport (proactive) improve air quality and reduce noise pollution. The studies reviewed by Markkanen & Anger-Kraavi [13] highlight that these benefits will accrue to low-income households which are often closely located to hydrocarbon plants, mining facilities and areas that suffer from disproportionate traffic congestion ([13], p. 832). In addition, Lamb et al. [15] indicate that their review fails to address to health outcomes but acknowledge some studies that indicate that energy retrofit programs have a positive impact on health ([15], p. 4).

On the whole, the literature reviews identify income and gender (in) equality as social outcomes that are related to the distribution of policy benefits. By contrast, our conceptual meta-review redefines existing wealth, income, gender, skill and mobility inequalities as *ex-ante* determinants of policy benefits in terms of participation/inclusion in C&LCTP. Ultimately, (the lack of) participation regulates which social groups and individuals become subject to positive social outcomes such as increased energy affordability/access, new employment opportunities and improvements in health.

Policy compliance transmission pathways. Transmission pathways associated with C&LCTP that are aimed at dis-incentivising the use of goods and services with a high carbon intensity can be discussed in terms of policy compliance costs. Markkanen & Anger-Kraavi [13] discuss the removal of fossil fuel subsidies and the introduction of carbon pricing/taxes (reactive policies), where the purchase of fossil fuels or carbon intensive goods embodies a policy compliance cost. The authors argue that the absence of compensation runs the risk of increasing income inequality since these measures increase the cost of essential goods and services such as food, energy and mobility. In turn, the households and social groups who spend a larger fraction of their income on these goods are affected most ([13], p. 835). Lamb et al. [15] review fossil fuel taxes and find that income inequality is typically reduced in low-income countries where significant fractions of the population are not in possession of motorised vehicles and wealthier households own a larger share of motorised vehicles. In middle- to high-income countries where a significant fraction of low-income households owns motorised vehicles, the studies find that income inequality is either worsened or unaffected ([15], p. 11). The author's findings on carbon and energy taxes are inconclusive and depend on whether the share of taxes (or essential goods subject to taxes) in total income or total expenditures is used to determine the cost of policy compliance across various households ([15], pp., 11-12). Lamb et al. [15] also point out how C&LCTP that aim to achieve a target percentage of renewable energy generation on regional or national scales require energy firms to invest in the generation of renewable energy to be compliant. Studies found that this policy compliance cost is often passed over to consumers through an increase in energy prices; resulting in a transmission pathway which is similar to that for feed-in-tariffs ([15], p. 20). Once again, our conceptual meta-review suggests that *ex-ante* income inequalities determine the distribution policy compliance costs which subsequently bear implications for the affordability of essential goods and services (social outcome).

3.2.2. On the feedback between social outcomes and inequalities

To sum up, the conceptual meta-review presented in Fig. 1 represents the result of our treatment of inequalities as *ex-ante* instances rather than *ex-post* social outcomes. Section 3.2.1 modified the main findings of the literature reviews by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15] to capture how systemic economic and social inequalities shape the nature of policy benefits, costs and compliance which ultimately result in social outcomes in terms of energy access, health, the affordability of essential goods and services, livelihoods and employment.

In addition, Fig. 1 also depicts a *feedback* between social outcomes and existing inequalities. In this way we relate specific social outcomes to a potential exacerbation or abatement of systemic inequalities. For example, if existing income inequalities result in a decrease of energy affordability, it is possible to conceive of a situation where low-income households, women or racial/ethnic minorities face additional constraints related to the ability to invest in education (skill inequality) or

take-up a mortgage (wealth inequality). While this represents an extreme example and the actual feedback is likely to be of lower intensity, we believe that this is a worthwhile consideration that is absent from the literature reviews due to their treatment of inequalities as ex-post social outcomes.

Fig. 1 also shows an element related to the risk of social conflict. This deliberation is taken from Markkanen & Anger-Kraavi [13] who argue that the exacerbation of inequalities as the result of C&LCTP diminish social cohesion which in turn may lead to social conflict ([13], p. 835). Of the various policies studied by Markkanen & Anger-Kraavi [13], the risk of social conflict is said to be highest for large-scale renewable energy projects such as hydroelectric dams, the closure of hydrocarbon plants and mining facilities and forestry carbon projects ([13], p. 833). Lamb et al. [15] report similar findings when it comes to renewable energy infrastructures that lead to land enclosures and the phase out of coal mining ([15], p. 20/21). While the literature reviews treat the risk of social conflict as a social outcome, our conceptual meta-review treats the risk of social conflict as a separate element: negative social outcomes as the result of C&LCTP may increase the risk of social conflict beyond the baseline level associated with systemic inequalities.

3.3. Inclusive transition policies

In specifying the negative social outcomes associated with C&LCTP, the literature reviews also discuss policy proposals that can mitigate their materialisation. Fig. 1 captures these proposals under the umbrella term Inclusive Transition Policies (ITPs) and relates their impact to transmission pathways and the inequality filter. Markkanen & Anger-Kraavi [13] and Lamb et al. [15] stress the importance of recognizing that disadvantaged groups and communities are more likely to experience negative social outcomes. As such, ITPs should ensure ample recognition, inclusion, representation and participation when it comes to both decision-making processes and project delivery ([13], pp. 836–837, [15], p. 23).

In terms of our conceptual meta-review, this means that the inequality filter should act as a guide for the groups and communities that need to be involved in the decision-making processes that impact the distribution of policy costs, benefits and compliance (inequality filter → ITPs → transmission pathway → social outcome). Markkanen & Anger-Kraavi [13] also highlight pro-poor approaches and argue that ITPs should ensure that the poorest households benefit most ([13], pp. 836–837). Along with Lamb et al. [15], they highlight that welfare gains or progressive outcomes have been achieved in cases where tax revenues were used either to reduce other taxes and/or increase transfers to low-income households (tax revenue recycling) ([13], p. 833/835, [15], pp. 11–12/21). In sum, ITPs can mitigate negative social outcomes by focusing on the recognition of existing inequalities, fostering participation in the design and delivery of C&LCTP and adopting fiscal tools to diminish existing inequalities and their subsequent impact on transmission pathways.

4. Recent considerations on climate and low-carbon transition policies, social outcomes and ITPs

In this section we amend the deliberations on C&LCTP and social outcomes with supplementary literature that was not included in the literature reviews by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15]. This literature was collected through an imputation of the following query in the SCOPUS database:

- “low-carbon transition” OR “low carbon transition” OR “ecological transition” OR “energy transition” OR “sustainability transition” OR “sustainable transition” OR “green transition” OR “climate policy”
- AND “social impact” OR “social conflict” OR “social effect” OR “injustice” OR “socio-economic impact” OR “economic impact” OR “economic effect” OR “economic barrier” OR “social barrier”

In addition, we've restricted the results to English journal articles published after 2019 and in the final stage of publication. The year 2019 was chosen to exclude papers that have already been reviewed in the aforementioned literature reviews. This search was conducted in October 2021 and yielded 9732 hits. This section only discusses 12 journal articles[3] that have been manually selected from the 9723 hits. This was done on the joint basis of relevancy and novelty. In terms of relevancy, we considered journal articles that explicitly considered either a) the impact of C&LCTP on multifaceted inequalities or b) the implementation of ITPs for the purpose of successful C&LCTP. Novelty, on the other hand, was used as a criteria to isolate contributions that provided insights on transmission pathways, social outcomes, inequalities and ITPs which have not been considered in the existing literature reviews on the social outcomes of C&LCTP. It should be stressed that the aim of this exercise was not to conduct a novel and more comprehensive literature review. Instead, this limited review should be seen as a procedure that casts the findings of more recent studies into our redefinition of inequalities as *ex-ante* instances that characterise the transmission from C&LCTP to social outcomes. The following subsections will discuss these contributions and relate them to the conceptual framework introduced in Fig. 1.

4.1. Exploring the “cutting edge” of C&LCTP outcomes literature

Table A in the Appendix relates the more recent stream of literature on C&LCTP and social outcomes to the conceptual meta-review introduced in Fig. 1. The rows of the table indicate the publication while the columns concern the various elements of the framework. When it comes to C&LCTP, we shortly describe the policy, whether it's proactive or reactive and which geographical location is taken into consideration. In order to disclose the transmission pathway from C&LCTP to social outcomes, we accentuate what type of existing inequalities are taken into consideration and whether these shape the pass-over of policy costs, benefits or compliance. In describing C&LCTP outcomes, we make a distinction between actual and potential social outcomes and summarise the findings of the respective publication. Finally, the last column provides a reflection on potential feedback between the highlighted social outcomes and existing inequalities. In doing so, we isolate the most obvious feedback bearing in mind that a particular social outcome can have complex repercussions for multiple inequalities.

Apart from nuclear energy expansion, most of the policy types addressed in this selection of publications have already been discussed in the literature reviews. When it comes to the existing inequalities, novel considerations include spatial inequalities related to the vicinity of households to low-carbon infrastructures, regional inequalities related to socioeconomic vulnerabilities and uneven development and between-country inequalities. In terms of social outcomes, health, employment and transition participation are recurring, while capabilities, credit access, working conditions and access to public goods have not been considered in the existing literature reviews.

All in all, the aim of Table A is to showcase how our conceptual meta-review can be used identify the actual and potential outcomes of C&LCTP against the backdrop of and with repercussions for existing and systemic inequalities. As mentioned in Section 3.2.1, our treatment of inequalities as systemic instances which determine the pass-over of policy costs, benefits and compliance to social outcomes shifts the focus of C&LCTP from the prevention of inequalities as a social outcome to the mitigation of inequalities altogether. This brings us to the following subsection on the more recent stream of literature concerning ITPs.

[3] It should be noted that the contribution by Larsen et al. [77] is from 2018 and was therefore not found in our initial set of articles. At the same, this paper was not reviewed by Markkanen & Anger-Kraavi [13], García-García et al. [14] and Lamb et al. [15] even if its findings are significant for the topic of our contributions.

4.2. Advancing the discourse on ITPs

Closely related to ITPs discussed in Section 3.3, are Transitional Assistance Policies (TAPs) introduced by Green & Gambhir [78]. The key difference between ITPs and TAPs pertains to the latter's emphasis on the distributive and welfare impact of C&LCTP on a predefined group of agents (states, corporations, workers, communities and consumers) and disregard for "the manner and extent to which affected groups are recognised and included in processes and procedures" ([78], p. 11) – a consideration which is imperative for ITPs (see Section 3.3). TAPs are supposed to allow transitions to occur in a more just, equitable and 'smooth' fashion and can be designed according to a specific objective and scope. A distinction is made between conservative and adaptive policy objectives. The former are backward looking and static. They are centered around the stabilisation of an agent's or group's interest over time by either partially or fully restoring the condition of said agent or group prior to transition-induced structural changes. Alternatively, adaptive objectives are forward-looking and dynamic. This means that agents and groups are facilitated in their adjustment to new circumstances instead of stabilised. This consideration allows us to conceive of ITPs in a more concrete fashion, particularly regarding the destination of tax revenue recycling. Table 2 below provides examples of various combinations between policy objectives and scopes:

Conservative and narrow TAPs are focused on compensation which includes unconditional financial payments aimed at the mitigation of transition-related financial losses incurred by agents or groups. Conservative and broad TAPs are focused on the legal exemption of some agents or groups from transition laws (e.g. related to climate change mitigation). Given that exemption preserves the pre-transition legal position of agents or groups it preserves both financial and non-financial aspects. Adaptive and narrow TAPs can be distinguished from conservative and narrow TAPs since involve conditional monetary payments and in-kind assistance to individuals and groups. The adjustment assistance is conditional in that they are aimed at facilitating the adaptation or transformation of agents and groups to new economic conditions. Examples of conditional monetary payments are equitable extensions of cash for the purpose of e.g. energy retrofitting, purchase of electric vehicles and bicycles and public transport passes. Instead, conditional in-kind transfers are usually related to relocation, support and extension of training to workers who have lost jobs in hydrocarbon industries. Finally, and according to the authors, TAPs should be adaptive and broad which means that they must include both financial and non-financial structural adjustment assistance. Examples of the latter are public employment schemes and public investment in local public goods of social, cultural and environmental nature. Casting this difference against the conceptual meta-review introduced in Fig. 1, we argue that conservative TAPs are aimed at the prevention of increased inequalities while adaptive TAPs bear the potential to mitigate existing but mostly economic inequalities. At the same time, however, it is important for adaptive TAPs to embed the recommendations pertaining to ITPs to guarantee the public acceptance and political sustainability of C&LCTP.

Where Green & Gambhir [78] expand on the scope and objective of what Fig. 1 refers to as ITPs, Kortetmäki & Järvelä [79] describe a case study where a social vulnerability matrix was constructed based on a workshop concerning the health and well-being impacts of national climate policies in Finland. While the participants were experts in various areas related to proposed C&LCTP (environmental, social and health scientists) their inputs resulted in a tool that associates various C&LCTP measures to hypothesised negative impacts on food security, energy security, material security, environmental health, physical health, mental health, cultural identity and social capital across various social groups. Evidently, this is a much broader spectrum of potential social outcomes than what is presented in Fig. 1. Still, we relate this study to ITPs since the authors suggest that the social vulnerability matrix can be used as a framework that fosters issue-based participatory decision-making and C&LCTP design. The social vulnerability matrix is seen as the starting point for active citizenship and building citizen-expert dialogues with experts and policy-makers.

The contribution by Hammond [80] also addresses participatory processes. In their treatment of sustainability transformations, the author draws on the normative concept of deliberation[4] and describes how deliberative approaches have been treated as a key ingredient for sound environmental policy making and sustainability. A distinction, however, is made between system-supporting deliberation and system-disrupting deliberation where the author argues that C&LCTP have thus far solely relied on the former. As a result, various social groups which participate in mini-publics or fora risk becoming just another player in a static policy process. In other words, Hammond [80] provides a critical reflection on participatory processes by highlighting that successful C&LCTP policies must additionally incorporate disruptive deliberation. This would allow social groups to transform policy processes rather than "decorating" existing policy processes.

Another critical reflection on participation is provided by Flipo et al. [81] which deploy a mobility justice framework and apply it to a case study of rural France. Mobility justice is a multi-scalar concept in that it operates on 1) the micro-level, concerning interpersonal relationships, b) the meso-level, which touches upon issues of urban transportation justice and the 'right to the city' and c) the macro-level which concerns transnational relations of travel as well as global resource flows and energy circulation. When it comes to sustainability goals, fuel-intensive mobility is seen as one of the main vulnerabilities of rural areas such as the Auvergne-Rhône-Alpes region. The authors provide an in-depth and critical assessment of public funding for the decarbonisation of transport. They find that public funding for sustainable mobility in rural areas is heavily decentralised and funneled to local authorities/municipalities that are supposed to provide extra-urban areas with tools that are meant to achieve decarbonisation. Examples of the initiatives and projects that have been implemented are hitch-hiking networks, carpooling and car-sharing schemes as well as the improvement of cycling infrastructure. On the one hand, this type of decentralised project-based public policy management serves to promote citizen engagement, participation and empowerment. At the same time however, making citizens the sole shoulder which carries the responsibility of mobility justice can be seen as a way for the central government to divest itself from its responsibility to address fossil-fuel dependency. This is particularly striking in light of the fact that half of public expenditures dedicated to the road network is used to build new roads or road infrastructure (295 euros per inhabitant per year) whereas the expenditure dedicates to the rail network and public transportation (215 euros per inhabitant per year) is mainly dedicated to maintenance rather than expansion. We argue that this contribution demonstrates that ITPs can also manifest themselves as a top-down outsourcing of responsibilities which may not be as equitable or effective.

5. Discussion

All in all, we contend that our conceptual meta-review and limited review of more recent literature offers a more complete but still partial

Table 2
Transitional assistance policy types. Source: Green & Gambhir [78].

Objective → Scope ↓	Conservative	Adaptive
Narrow	Compensation	Structural adjustment assistance
Broad	Exemption	Comprehensive adaptive support

[4] Used by the author as a normative concept which represents an ideal of democratic communication between political actors e.g. citizens, politicians, organisations and authorities which ultimately results in deliberative democracy at the level of society and the political system ([80], p. 10).

exploration of the relation between C&LCTP and social outcomes. This partiality is the result of some open questions or aspects which the literature fails to address in a comprehensive fashion. Evidently, this is related to either a general lack of case studies or the fact that not enough time has passed since the implementation of C&LCTP.

The first open question is related to the fact that most of the literature is limited to an assessment of C&LCTP which aim to reduce carbon emissions in energy and transport sectors. An equally important aspect of the low-carbon transition, however, is related to land use changes and agricultural practices. In 2014, this category accounted for approximately 24 % of global greenhouse gas emissions [82]. As such, it is important to understand the social outcomes of C&LCTP that aim to transform the agricultural sector into a low-carbon variant. Furthermore, the environmental impact of agriculture not only depends on its carbon or greenhouse gas emissions but also on the impact of agricultural practices on biodiversity, water and soil quality and animal welfare [83].

The second open question regards the effect of reduced income inequality on the carbon intensity of consumption [84–86]. According to the literature which addresses this question, the short-run net-effect of a reduction in income inequality as the result of lower incomes for e.g. the top 10 % of households and higher incomes for the bottom 10 % of households may well be an increase in overall emissions. This is due to the stylised fact that low-income households are more likely to increase their consumption because of income increases. By contrast, high-income households are less likely to decrease their consumption as the result of income decreases. This is an economic phenomenon that has been highlighted throughout the range of economic schools of thought and empirically verified to various extents [87–91]. Evidently, the rebound effect of redistributive policies can be mitigated if C&LCTP ensure that the new consumption possibilities (as well as the production thereof) for low-income households are significantly less carbon intensive or, more radically, introduce policies which specifically target the marginal propensity to consume across households (see e.g. [92]).

Our last reflection concerns ITPs and the contributions by Hammond [80] and Flipo [81] which demonstrate that the implementation of participatory processes and deliberative approaches is not always guaranteed to be a success. While one-off deliberative events to increase the public support and acceptance of C&LCTP can act an avenue for the ventilation of anger and frustration experienced by citizens and politicians, experience shows that they are rarely successful due to the lack of specialised staff, funds, infrastructure and inaccurate representation of the socio-economic diversity reigning in society [93,94]. There is a strong necessity to rethink and redefine the existing democratic processes that are intimately tied to prevailing institutions that perpetuate economic and social inequalities through the preservation power pertaining to incumbent interests [95]. Nancy Fraser's contribution on rethinking the public sphere challenges weak publics or the status quo of deliberative arenas. The author highlights how participation is sidestepped by economisation: the reduction of issues, concerns and interests to impersonal market imperatives and technical problems for managers and planners to solve ([96], p. 36). Such a reduction protects dominant groups and individuals while side-lining their subordinates thus ultimately justifying existing institutions. As promising as the combination between ITPs and broad and adaptative TAPs sound, one can argue that economisation still constitutes its rationale. If system-disrupting participatory and deliberative processes are limited precisely by existing socioeconomic structures and political institutions, then perhaps it's time to focus on the origins of this limit: the capitalist firm where private property and the objective of profit maximisation undermine the pursuit of democratically chosen aims [97,98]. Against this background, a compelling avenue for further research is the intersection between workplace democracy and C&LCTP. In doing so, it is important to acknowledge a) both paid and unpaid work and b) that the goods and services consumed within national and regional borders encompass international workplaces.

6. Conclusion

The aim of this paper was to present a conceptual meta-review of the literature that clarifies the link between C&LCTP and social outcomes. The meta-review draws on three existing literature reviews that identify various transmission pathways (from policy to social outcomes). The various C&LCTP addressed by the literature were divided into a proactive and reactive category. Where the former concerns the low-carbon transformation of society and the latter is directed towards the reduction of carbon-intensive production and consumption activities. Our meta-review distinguishes itself from the existing literature reviews by assuming that transmission pathways are determined by an inequality filter that shapes the nature and distribution of policy costs, benefits and compliance. It is this pass-over which conclusively determines the social outcomes of C&LTP. Put differently, our conceptual meta-review critically engages with the delineation of social outcomes in the literature reviews. Instead of treating increased economic and social inequalities as the social outcomes of C&LCTP, Fig. 1 redefines and depicts inequalities as *ex-ante* and systemic instances. Fig. 1 also assumes that social outcomes can feed back into the inequality filter and either weaken or strengthen existing inequalities. Apart from this, negative social outcomes can elevate the risk associated with social conflicts beyond its baseline level determined by existing inequalities. Finally, the conceptual meta-review illustrates Inclusive Transition Policies (ITPs), which represent the various policy measures that the literature reviews propose for the prevention of negative social outcomes. These measures include the recognition of existing inequalities, the inclusion of vulnerable groups and communities, their subsequent participation in decision-making and project delivery and tax revenue recycling. While the literature reviews argue that such measures should be introduced to prevent the aggravation of inequalities, the redefinition of inequalities introduced in Fig. 1 suggests that the mitigation of systemic inequalities is necessary to prevent the transmission from C&LCTP to negative social outcomes.

Since the literature on C&LCTP and social outcomes has been steadily increasing, we also provide a limited review of recent contributions and relate their findings to the conceptual meta-review. The bulk of these contributions highlight previously unconsidered inequalities (spatial, regional, between-country) and social outcomes (capabilities, credit access, working conditions and access to public goods). Another topic discussed in these contributions builds upon the ITPs and provide a more thorough discussion of their scope, objectives and critical reflections on participatory policy-making. Nevertheless, some open questions are still present. Considerations on C&LCTP and their social outcomes beyond the sphere of carbon emission reductions in energy and transport sectors are still lacking. Another under-explored area is related to whether both negative social outcomes and diminished inequalities reduce the effectiveness of C&LCTP in terms of emission targets. Finally, we rehash the critical reflections on the effectiveness of ITPs in the face of socio-economic and political structures that use participatory and deliberative processes to validate their preservation and the associated perpetuation of systemic inequalities. We contend that each of these questions should be taken up in future research on C&LTP and social outcomes. Ultimately, we hope that this conceptual meta-review offers policy makers and scholars an alternative perspective on the interaction between systemic inequalities C&LCTP and social outcomes.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Appendix A

Table A
Recent C&LCTP outcomes literature.

	Framework elements				
Literature	Transition policy	Existing inequalities	Transmission pathway	Social outcomes A: actual – P: potential	Feedback
Larsen et al. [77]	**Pro-active** Renewable energy projects in Denmark	**Spatial** Related to the vicinity of households to wind turbines	Costs	**Health (A)** Survey results indicate that the increased noise levels of wind turbines led to decreased concentration levels and sleep deprivation. **Personal property devaluation (P)** Respondents also expressed concern over a decrease in their future ability to take up loans since the value of personal property may decrease due to the presence of wind turbines.	Personal property devaluation could potentially exacerbate wealth inequalities.
Bartiaux [99]	**Reactive** In general	**Income** Household level energy affordability	Compliance	**Diminished capabilities (P)** 2009 survey data from Austria, Belgium and Bulgaria reveal significant capability gaps between energy poor and energy rich households. In Austria the largest capability gap was related to control over one's material environment where 14.7 % of energy poor households were unable to afford standard household appliances compared to 1.07 % of energy rich households. In Belgium the largest gap was found for play (66.4 % vs 5.84 %) while Bulgaria faced the largest gap when it came to play and bodily health, representing a 70.1 % and 30.92 % gap respectively.	Capability gaps related to the material environment as well as bodily health can potentially exacerbate existing inequalities. For example, a higher labour intensity of social reproduction due to a lack of household appliances as well as poor health can affect the development of skills required for higher paying jobs.
Sovacool et al. [100]	**Pro-active** Nuclear energy expansion in France	**Spatial** Related to vicinity to nuclear facilities	Costs	**Health (P)** Interviewees expressed concerned over the higher risk of exposure to nuclear waste and serious cross-boundary consequences in the case of an accident.	Depending on the location of nuclear facilities, negative health outcomes can exacerbate various inequalities as the result of health care expenditures.
	Pro-active Electrical vehicle deployment in Norway	**Between-country**		**Working conditions (P)** Given that low-carbon technologies exert an increased pressure on the demand for low-carbon raw materials (uranium, lithium, cobalt etc.), interviewees expressed concern over deteriorating working conditions and increased environmental risks in developing and resource-abundant countries (see [101–104])	Deteriorating working conditions and diminished environmental quality in developing countries sustain uneven development and between-country inequalities. Diminished access to public goods and the resulting decrease in the quality of public transport bear the potential to exacerbate existing inequalities with respect to mobility.
		Income Individual level		**Access to public goods (A)** Wealthier individuals who can afford the initial investment in electric vehicles are granted the permission to drive on bus lanes. Interviewees noticed that the upsurge in electric vehicles has caused traffic congestion. This has diminished the access to roads (a	

(*continued on next page*)

Table A (*continued*)

	Framework elements				
Literature	Transition policy	Existing inequalities	Transmission pathway	Social outcomes A: actual – P: potential	Feedback
				type of public good) to individuals who are dependent on public transport.	
Fleming-Munoz et al. [105]	**Reactive** Hydrocarbon plant closures in Queensland, Australia	**Regional** On the basis of latent economic vulnerabilities to emission reductions (LEVER).	Costs	**Employment (P)** The LEVER index represents the ratio between the proportion of jobs that depend on carbon intensive industries and the share of employment in export-oriented sectors with low carbon intensities. The authors use this index to assess regional vulnerabilities in terms of employment as the result of hydrocarbon plant closures.	In absence of complementary and regionally calibrated policies the implementation of transition policies that lead to hydrocarbon closures can exacerbate regional socioeconomic inequalities.
O'Sullivan et al. [106] and Golubchikov & O'Sullivan [107]	**Pro-active** Policies related to low-carbon energy infrastructures in Wales, UK	**Regional** On the basis of uneven development between the core and periphery.	Benefits	**Transition participation (A)** Unlike the energy-core, the energy-periphery, is said to be systematically disadvantaged throughout the entire energy system (ranging from generation, distribution and consumption). This theoretical distinction is applied to both the UK vis-a-vis Wales, urban Wales vis-a-vis rural Wales and rural Wales in and of itself. The authors highlight that transition policies in the UK have only benefited a limited range of households in rural Wales while the majority of households remain locked into carbon-intensive technologies.	Without concrete "de-peripheralisation" participation in the low-carbon is severely limited. This reinforces the regional socioeconomic inequalities.
Semeniuk et al. [108]	**Reactive** Closure of various hydrocarbon sectors or sunset industries ranging from energy production to extraction and exploration.	**Skills and mobility** With respect to the re-employment of workers hydrocarbon sectors. **Wealth and income** With respect to how income levels and wealth impact individual credit-worthiness.	Costs	**Employment (P)** Investment losses faced by capital owners can feed back into job losses. **Credit access (P)** The closure of sunset industries can lead to significant asset losses which increase the likelihood to default on debts as well as the share of a bank's non-performing loans. This can feed back into credit-rationing which can either increase interest rates or decrease the amount of investments. Each of which limit an individual's access to credit for the purpose of purchasing a home or starting a business.	Both unemployment and restricted credit access bear the potential to exacerbate wealth and income inequality.
Owen & Barett [109]	**Reactive** Energy efficiency measures in Great Britain	**Income** Household level	Compliance	**Maintenance of existing inequalities (A)** Transition policy cost analysis reveals that the bottom 10 % of households contributed 271 million pounds to energy efficiency measures in 2016 through an increase in energy costs. At the same time, the cost of energy efficiency schemes targeted at low-income households was 220 million pounds; indicating that low-income households are over-funding themselves.	A potential feedback cannot be discussed here since the social outcome is the maintenance of existing inequalities due to the fact that low-income households appear to self-fund energy efficiency measures.

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