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Ideological obstacles to effective climate policy: The greening of markets, technology, and growth

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Abstract

In light of the 2015 Paris Climate Agreement, this project synthesizes and advances critiques of the possibility of a sustainable capitalism by adopting an explicit 'negative' theory of ideology, understood as ideas that conceal contradictions through the reification and/or legitimation of the existing social order. Prominent climate change policy frameworks – the 'greening' of markets (market-corrective measures), technology (alternative energy, energy efficiency, and geoengineering), and growth (the green growth strategy) – are shown to conceal one or both of the two systemic socio-ecological contradictions inherent in the current social formation: (1) a contradiction between capital's growth-dependence and the latter's degrading impact on the climate (the 'capital-climate contradiction') and (2) a contradiction between the potential of using technological infrastructure that aids in emissions reductions and the institutionalized social relations that obstruct this technical potential (the 'technical potential-productive relations contradiction'). Attempts to reform the very techniques and institutions that brought about the climate crisis will remain ineffective and reproduce the

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social order that results in climate change. After proposing a way in which societies might move out of the ideological trappings of green markets, technology, and growth, two alternatives are proposed: economic degrowth coupled with Marcuse's conception of a 'new technology'.

Keywords
alternative energy, cap and trade, carbon market, degrowth, emissions trading, energy efficiency, geoengineering, green growth, ideology critique, UN Framework Convention on Climate Change COP21 2015 Paris Agreement

Introduction

Stoner and Melathopoulos (2015) succinctly articulate an 'environment-society problematic' (p. 22), a paradox that confuses and worries many: 'environmental degradation increases amid the growth of environmental attention and concern'. Or, as Blühdorn (2007) puts it, why are we sustaining 'what is known to be unsustainable'? (p. 272) What processes allow for the *reproduction* of the ecologically destructive practices and institutions of modern societies despite the knowledge that they are undermining human life support? While there are a number of likely and interrelated processes that may perpetuate such seemingly paradoxical circumstances, a growing number of scholars are pointing to *ideology* as a prime culprit (Bell & York 2010; Dunlap & McCright 2015; Foster 2010; Hornborg 2001, 2009; Nyberg & Wright 2013; Wright & Nyberg 2014, 2015). For example, Foster (2010) argues that the 'technological fetishism' and 'market fetishism' underpinning prominent solutions to the environmental crisis are 'strategies for denial', an argument that is a primary inspiration for this project. Technological fetishism is seen in the prevalence of strategies to increase the efficiency of technologies as well as an extreme version in recent calls for geoengineering. Market fetishism is seen in the rising popularity of market-based climate change mitigation policies, namely cap-and-trade schemes. The most recent examples are found in Articles 6 and 10 of the Paris Climate Agreement of the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC 2015). Although the Paris Agreement does not explicitly discuss emissions trading in Article 6, it does recognize that Parties to the Agreement (national governments) may utilize 'internationally transferred mitigation outcomes'. The somewhat difficult wording of Article 6 'provide[s] the ability to create an international market if any Parties so desire' as well as 'the means to create a process that may/will lead to the convergence of domestic carbon prices over time' (Marcu 2016: 6). Article 6 also establishes an unnamed 'mechanism', which some have dubbed the 'Sustainable Development Mechanism', that will likely succeed and be akin to the Kyoto Protocol's Clean Development Mechanism (CDM), which allowed industries in developed countries to invest in emission reduction projects (carbon offsets) in developing countries in order to increase greenhouse gas (GHG) emission caps (Center for Climate and Energy Solutions 2015; UNFCCC 2015, Article 6.4-6.7). Article 10 of the Paris

Climate Agreement establishes a 'Technology Mechanism' to increase climate technological innovation, development, and transfer for reducing GHG emissions and, among other things, promote economic growth.

In light of the Paris Agreement, this article examines the relationship between ideological forms and popular climate policy frameworks to address climate change (hereafter climate policy). It makes two contributions to the literature. First, we develop earlier frameworks concerning ideology's role in maintaining unsustainable human–nature relations by drawing from Larrain's (1979, 1982, 1983) explication of Marx's 'negative' theory of ideology. While different processes of ideological formation and ideological content have been identified in the context of human–nature relations, discussed in the proceeding section, we elucidate different *forms* by which systemic socio-ecological contradictions are concealed by adopting Larrain's (1982) typology of contradiction-concealment: contradiction denial, misunderstanding, displacement, and dilution. Furthermore, we contribute to literature on how society might move beyond current ideological trappings in the context of the environmental crisis by engaging Therborn's (1980) analysis of what social or ecological changes must take place to diminish or terminate ideologies that hamper effective climate change action. We address the question, What will it take for 'green' markets, technology, and growth to be seen as empty promises that conceal systemic socio-ecological contradictions? We also link climate change politics to larger anti-capitalist movements and discuss a strategy that both creates alternatives and challenges structurally-situated power. More broadly, this article can be seen as an attempt to advance, through the context of climate policy, and consolidate other critiques of efforts to 'green' capitalism through technological and market-based means (e.g. Clark & York 2005; Dale et al. 2016; Foster 2009; Foster et al. 2010; Hornborg 2001; Klein 2014; O'Connor 1998; Wright & Nyberg 2014, 2015; York & Rosa 2003; for overviews of Marxist approaches in environmental thought, see Castree 2000; Foster 2016).

The second contribution of this project is a novel assessment of prevalent climate policy frameworks. In comparison with mainstream climate policy assessments, a theory of ideology takes us beyond positive policy analyses and projections of potential effectiveness. While the latter assessments are, by definition, imperative for selecting more effective climate change policies, the theory of ideology can uncover the assumptions of policies that *reproduce* an inherently unsustainable social order by masking underlying systemic contradictions. Although observed or projected effectiveness or ineffectiveness may assist the latter argument concerning ideology, the argument concerning ideology sits outside the self-imposed restrictions of empirical policy analysis. We suggest that the inability to reduce GHG emissions through the most popular approaches to climate policy stems from ideological assumptions underlying climate policy.

In what follows we first outline the 'negative' theory of ideology, drawing primarily from Marx as elaborated by Larrain. Following, two systemic contradictions related to climate change are identified: the capital-climate contradiction and the technical potential-productive relations contradiction. We then argue that three prominent climate policy mechanisms are founded on assumptions that mask one or both of these systemic contradictions: greening markets; greening technology; and

greening economic growth. Following, we outline the theory of ideological change and propose two alternative climate mitigation strategies that do not conceal the identified systemic contradictions: (1) degrowth and (2) a 'new' Marcusian technology. We conclude that effective and long-term climate mitigation depends on social alternatives to the current order.

The negative conception of ideology

Ideology is a thorny and elusive concept so it is important to clarify what we mean by the term. We apply a conception of ideology drawn primarily from the Marxist tradition, where the term refers to ideas that conceal contradictions (Larrain 1979, 1982, 1983). Although this is a 'negative' (Larrain, 1979) or 'critical' (Thompson 1984) conception rooted in Marx and Engels' (1977) critique of the Young Hegelians, this particular critical meaning should not be confused with a common use of the term as an insult, for example, implying an inability to be reasonable or undogmatic (e.g. Gouldner 1976: 4). It should also be distinguished from more neutral conceptions of ideology developed since Marx, both in the Marxist (e.g. Althusser 1971; Gramsci 1971; Lenin 1975; Lukács 1971) and non-Marxist (e.g. Mannheim, 1936) traditions. While we recognize the importance of neutral conceptions of ideology and draw from them, especially Therborn's (1980) theory of ideological transformation, our primary aim is to illuminate ideas that conceal systemic contradictions. In other words, when drawing from neutral conceptions of ideology, we recast them in the 'negative' or 'critical' sense of the term.

Ideologies conceal contradictions through descriptive, explanatory, and/or normative claims and implicit or explicit assumptions that (1) grant legitimacy to the social order (*legitimation*) and/or (2) conceive of the social order as natural and immutable (*reification*) (for similar formulations, see Lukes 1974; Thompson 1984). Reification is always an implicit legitimation of what is by assuming the immutability of the social order. If Therborn (1980) is right that two modes of ideological 'interpellation' (Althusser 1971) relate to what exists and what is possible, reification narrows down what is possible by naturalizing what is. In other words, even when there are no explicit justifications for what is, when ideology 'hardly says more than things are the way they are', the implicit message is, 'it could not be otherwise than it is' (The Frankfurt Institute of Social Research 1972: 202). Another way in which ideology reproduces the social order, as explained by Gramsci (1971), is through ideological hegemony, or dominant class rule through a consent gained by intellectual and moral leadership as opposed to state power and coercion. We draw from neo-Gramscian ideas in the environmental social sciences (Levy & Egan 2003; Levy & Spicer 2013; Nyberg et al. 2013) in the section 'How to overcome ideology' to uncover ways in which we may move beyond ideology in climate policy.

There are a handful of studies containing arguments that approximate what we mean by ideology in the context of human–nature relations (Bell & York 2010; Foster 2010; Hornborg 2001, 2003, 2009; Nyberg & Wright 2013; Wright & Nyberg 2014, 2015). Wright and Nyberg (2014, 2015; Nyberg & Wright 2013) have identified many of the specific organizational-level mechanisms used by corporations to conceal

contradictions related to climate change. For example, corporations incorporate critiques of capital's role in climate change through the creation of myths, such as corporate environmentalism (framing the corporation as a central climate change mitigation actor) (Wright & Nyberg 2014). They maintain that criticisms are recuperated in a way that *reproduces* capitalism's unsustainable relation with the environment by *legitimating* the existence of corporate capitalism. This conception is akin to Bell and York's (2010) analysis of ideology as a legitimation process for coal interests in West Virginia, where the coal industry propped up a pseudo-grassroots organization ('Friends of Coal') to manufacture an ideological cultural and economic identity for the region.

As noted in the introduction, Foster's (2010) use of the terms 'technological fetishism' and 'market fetishism' are in line with what we mean by ideology and, further, provides the seeds to an argument which we expand upon in this article. For Foster (2010), technological fetishism and market fetishism are obstacles to forming a real solution to the environmental crisis. They are not only ineffective, but exist as a form of environmental crisis denial 'that serves the vested interests of those who have the most to lose from a change in economic arrangements' (Foster 2010). Hornborg (2001, 2003, 2009) makes a similar argument at a global level regarding the contradiction-concealing character of faith in market- and technology-based solutions to environmental destruction. For example, since around the mid-1970s, and especially since the 1990s, there has been a 'discursive shift … geared to disengaging concerns about environment and development from the criticism of industrial capitalism as such' (Hornborg 2003: 207). In addition to 'machine fetishism' (discussed in section 'The ideological greening of technology via displacement'), Hornborg argues the common belief in the Global North that economic growth is not antagonistic to environmental quality – now cast as the 'green growth' strategy that is discussed below – reproduces the *world* system of unequal exchange.

While the meso-level *mechanisms* of ideological formation (Bell & York 2010; Nyberg & Wright 2013; Wright & Nyberg 2014, 2015) and ideological *content* (Foster 2010; Hornborg 2001, 2003, 2009) have been identified in the environmental social sciences, we further this area of inquiry by elucidating what *forms* contradiction-concealing ideas can take in the context of climate policy. Here, we draw from Larrain's (1982) typology of four forms of contradiction-concealment: denying, misunderstanding, displacing, and diluting contradictions. *Denial* conceals contradictions by disregarding or rejecting the existence of a given contradiction, even via intentional falsification. Climate change denialism is a clear recent example (Dunlap & McCright 2015). *Misunderstanding* occurs when a given contradiction is acknowledged yet misinterpreted in a way that makes it impossible to put forth a real solution to the contradiction. *Displacement*, a specific form of misunderstanding, is when a given contradiction is acknowledged yet mistakenly projected on related though different elements (e.g. when negative effects are interpreted as causes). *Dilution* occurs when a given contradiction is acknowledged, but there is an attempt to weaken the contradiction by *conceptually* reconciling irreconcilable elements. The denial, misunderstanding, displacement, or dilution of contradictions via the legitimation and reification of the social order is a necessary condition for the *reproduction* of any contradictory social

formation, such as capitalism. We apply Larrain's typology after describing two systemic socio-ecological contradictions at the heart of the climate crisis.

Two systemic socio-ecological contradictions related to climate change

As detailed in the previous section, ideologies refer to ideas that conceal real contradictions. There are two systemic socio-ecological contradictions that concern us here:[1]

1. The contradiction between capital's need to expand production, on the one hand, and the destructive effects expansionistic production has on the conditions of production, specifically the climate system, on the other (hereafter, the 'capital-climate contradiction').
2. The contradiction between the technical potential of adopting an already available technology to aid in the reduction of GHG emissions, on the one hand, and the institutionalized social relations that hamper this technical potential, on the other (hereafter, the 'technical potential-productive relations contradiction').

The capital-climate contradiction, which Wright and Nyberg (2014, 2015) accurately term a 'creative self-destruction', is a specific example of O'Connor's (1998) 'second contradiction of capitalism' (p. 162), whereby 'individual capitals defend or restore profits by strategies that degrade or fail to maintain over time the material conditions of their own production'. The environment is conceived of as a condition of production as all commodity production depends on the biophysical environment not only for inputs, but also for its very existence and reproduction, including a livable climate system. Weis (2010: 318–319) describes O'Connor's second contradiction well in the context of climate change: 'The failure to account for the atmospheric burden associated with fossil energy, and its impact on the Earth's climate system, represents one of the most fundamental biophysical contradictions of industrial capitalism'. The capital-climate contradiction is built into the basic structures of capitalist societies. As detailed by the 'treadmill of production' theory, first systematized by Schnaiberg (1980), capitalist economies must constantly expand production, creating a production cycle (a 'treadmill') that increases energy and material throughput ('withdrawals') and 'additions' into the environment in the form of pollution. This general perspective has been reiterated in relation to climate change in various ways (for review, see Antonio and Clark 2015: 352–357) and macro-level empirical research shows that economic growth is a major driver of GHG emissions (e.g. Jorgenson & Clark 2012; York et al. 2010; York & Rosa 2003). In short, capitalism is growth-dependent and boundless economic growth is a major driver of climate change, an effect that will, over time, degrade a condition of production (the climate system).

The technical potential-productive relations contradiction, an ecological rendition of the contradiction of the forces and relations of production, is summarized well by Foster (2002), which can be broken down into three claims:

> [(1)] It is not technology that constitutes the problem [of ecological unsustainability] but the socioeconomic system itself. [(2)] The social-productive means for implementing a more sustainable relation to the environment within the context of a developed socioeconomic formation are available. [(3)] It is the social relations of production that stand in the way. (p. 101)

The basis for the first claim – that there is nothing essential about technological development that creates unsustainable relations with the environment – rests on the assumption that technical artifacts are shaped and directed by social structures and group interests. While some technics have destructive impacts, it is due to social interests and goals embedded 'in' them. We agree with this assumption and, drawing from the work of Herbert Marcuse (e.g. 1964), elaborate on it below. The second claim is that society already possesses the productive technological means to bring forth a more ecologically sustainable society and, specifically in the context of climate change, reduce GHG emissions. While greener technics are not an autonomous solution to climate change, as made clear in the section 'The ideological greening of technology via displacement', they have the *potential* to *contribute to* a reduction in GHG emissions when applied in different social conditions. However, this potential depends on the social structures and interests that condition them. As stated in a recent review of the anthropogenic drivers of climate change,

> One of the most important overall lessons of sociological research on the anthropogenic forces driving global climate change is that it is necessary to look beyond technical fixes and consider the social, political, and economic structures that condition human behavior and resource exploitation. Developing more efficient and less polluting technologies without also altering institutions and social structures may not be sufficient to substantially reduce GHG emissions, since political-economic systems have many dynamic feedbacks that may prevent technological fixes from having their intended effects. (Rosa et al. 2015: 52)

We agree with Foster's third claim that current institutionalized social relations are a barrier to the aim of using technology as a means to help reduce GHG emissions. By 'institutionalized social relations', we mean the private ownership of productive forces for the incessant accumulation of capital, which reproduces the treadmill of production described above. Thus, the technical potential-productive relations contradiction is intimately connected to the capital-climate contradiction. All three points are expanded upon in sections 'The ideological greening of technology via displacement' and 'New technology'.

Our primary argument is that dominant climate policy mechanisms are based on assumptions that conceal one or both of these systemic socio-ecological contradictions. Climate policies which seek to reform markets within the existing social order conceal the capital-climate contradiction by *misunderstanding* the contradiction (section 'The ideological greening of markets via misunderstanding'). Climate policies which attempt to green technology within the constraints of the existing social order conceal the technical potential-productive relations contradiction by contradiction *displacement* (section 'The ideological greening of technology via displacement'). The

green growth strategy is an example of climate policy that conceals both contradictions through *dilution* (section 'The ideological greening of growth via dilution'). The effect of concealing these contradictions is twofold: (1) ineffective policy and (2) the reproduction of an inherently unsustainable social order.

The ideological greening of markets via misunderstanding

A growing number of climate change policies call for the greening of markets, specifically through emissions trading or carbon markets, usually a combination of cap-and-trade and carbon offsets schemes. For example, as discussed in the introduction, Article 6 of the Paris Agreement establishes a new carbon offset mechanism and leaves open the possibility for an international carbon market. Emissions trading schemes are being discussed and implemented in a growing number of cities, countries, and regions, including New Zealand, the northeastern US, Quebec, California, Australia, South Korea, and the European Union (the Emissions Trading System) (EU ETS), the oldest and largest carbon market born out of the Kyoto Protocol (Lohmann 2005; Newell et al. 2013). The idea of emissions trading is to make fossil fuel sources economically scarce through imposed emission limits (the 'cap') and assigning tradable legal rights to emit (the 'trade'). The prices created through bargaining will, in theory, represent how much society 'values' the resource (Lohmann 2005), or, 'the value of the environmental impact of carbon dioxide emissions or the potential shifts in wealth as those emissions are constrained and property rights conveyed' (Newell et al. 2013: 125). Carbon offset schemes refer to investing in business ventures or infrastructure, usually in developing countries, that are supposed to lead to lower GHG emissions than if investments had not been made. When coupled with cap-and-trade schemes, investing in carbon offsets allows polluters to emit more.

Most research on the effectiveness of emissions trading has focused on the EU ETS (for review, see Newell et al. 2013). Perhaps the most positive report estimates a 2%–5% emission reduction from 2005 to 2007 when compared to business as usual projections (Ellerman et al. 2010). Yet, the EU ETS has certainly failed to significantly reduce total EU emissions (for overview of first two phases, see Carbon Trade Watch 2011), there is little proof for resultant long-term investment in new technologies (Leiter et al. 2011), and, most famously, one could trade a permit to pollute a ton of carbon for cents in 2007 due to an oversupply of allowances following industry lobbying and the CDM market collapsed in 2012 (Newell et al. 2013). There was a great deal of technical discussion on how to improve the EU ETS for the third phase, which started in 2013 (for review, see Newell et al. 2013) although the resulting model effectively reproduced the basic features of the first two phases (Carbon Trade Watch 2011). Like Melathopoulos and Stoner's (2015) critique of ecosystem service valuation, we agree that assuming that past limitations and inadequacies of market-based reforms are due to technical issues neglects a larger question: the relationship of these programs to current social-structural conditions. It is clear that market-corrective climate policies recognize a contradiction between capital accumulation and the climate system. For example, non-commodified environments

are indeed harmed because they are not considered economically valuable (O'Connor 1998). However, as we argue below, they *misunderstand*, through the reification of historically contingent categories, the capital-climate contradiction by ignoring the structural conditions that give rise to its existence.

Cap-and-trade and carbon offset schemes are based on beliefs inherited from mainstream environmental economics, where the environment is recast as 'natural capital' (e.g. Hawken et al. 1999) and formerly non-commodified natural entities or classes of entities are given price values (Foster et al. 2009). Monetary valuation schemes assume that environmental degradation and problems result from non-commodified (unpriced) natural resources being used or polluted without compensation to harmed (human) parties (Van den Bergh 2000). Environmental harms ('negative externalities') are not accounted for either in the market price of the product or in the product's production costs. The solution, according to environmental economics, is to internalize negative externalities. One way to do this is to create new markets with incentive systems via state intervention and policy after introducing clearly defined property rights of environmental goods and services. Although there are a number of examples (e.g. tradable harvest rights in the fisheries industry, wildlife enhancement schemes, biodiversity credit schemes, debt for nature swaps, and wetland mitigation banks), we are primarily concerned with the ideological assumptions underlying emissions trading.

Environmental economic valuation schemes and their various applications have been criticized by environmental ethicists, neo-Marxists, ecological economists, and others for a number of reasons (e.g. Adaman & Özkaynak 2002; Foster 2002; Foster et al. 2009; Kosoy & Corbera 2010; Robertson 2004; Smith 2007; Stoner & Melathopoulos 2015; Van den Bergh 2000; Wright & Nyberg 2015). Three common critiques are especially helpful for illuminating the ideological assumptions presupposed in emissions trading: (1) it is problematic to reduce the totality of nature's value to price values, (2) increasing the scope of capital's penetration of nature will only serve to perpetuate the structural causes of environmental problems, and (3) technical market-based solutions implicitly demote alternative approaches.

Climate policies that rely on monetary valuation schemes like emissions trading conceal the capital-climate contradiction by reducing the value of nature to a 'sum of private values' (Van den Bergh 2000: 7). Foster et al. (2009) analogize these schemes to the Greek myth of King Midas, to whom Dionysus granted his wish for everything he touched to be turned to gold, later to find that he could not eat or drink. In this analogy, the God of the practitioners is their pre-existing conditions, a socio-economic system that persists through profit-maximization via commodification and the expansion of production, and the unintended consequence is as follows: 'putting price tags on species and ecosystems will only serve in the end to subsume nature to the endless growth of production and profits' (Foster et al. 2009: 1090). Or, as Robertson (2006) puts it in the context of ecosystem service valuation, nature must be placed in a form that 'capital can see'. In the same way that 'the modern businessman sees in the landscape an opportunity for the display of cigarette posters' (Horkheimer 1947: 104), power and energy industries and technocrats see the climate system as an accumulation strategy (Smith 2007).

This argument is distinct from the claim that the monetary valuation of carbon sequestration sites or allotting national allowances to pollute are empirically problematic or unethical practices – though these claims may very well be true – and posits that such practices naturalize and implicitly justify the contradictory social conditions that brought about the climate crisis. The assumptions underlying emissions trading schemes misunderstand and thus conceal the nature of the capital-climate contradiction by, for example, recommending the *expansion* of the commodification of the environment rather than its reduction or dissolution. The latter type of thinking, calling for the reduction or dissolution of nature commodification, is only possible if one recognizes the historical contingency of current conditions (i.e. not reifying what is). Monetary valuation schemes do not recognize the inherent contradiction in reducing nature to 'natural capital', although a necessary reduction in capitalist societies. A non-ideological approach to climate policy would require starting with, not concealing, the capital-climate contradiction. This would also lead to a radically different approach to climate change policy: decommodifying the environment, as opposed to its further commodification.

Climate policies that rely on market reforms relegate social alternatives that may actually address the capital-climate contradiction. This argument is detailed well by Lohmann (2005) in the context of the Kyoto Protocol, where the primary policy mechanism (emissions trading) effectively redirected intellectual and financial resources from innovations and social changes that have the potential to reduce total emissions. Alternative social futures that lie outside national allowances of now-commodified carbon dioxide pollution and other reified categories are marginalized. Lohmann (2005) details how environmental criticisms of Kyoto were scorned as a 'do-nothing' stance. Additionally, the treaty is thoroughly technocratic and corporatist, which excludes input and solutions from nonprofessional and noncorporate groups. In short, another ideological function of emissions trading is the reproduction of the capital-climate contradiction through the implicit rejection of alternative social futures.

To summarize, the assumptions presupposed in market-based solutions to climate change misunderstand the capital-climate contradiction by reifying or naturalizing social and historically contingent categories and projecting them onto natural properties. While market-based climate policies are a response to the capital-climate contradiction, they misunderstand the nature of the contradiction, thereby reproducing the same conditions that helped bring about the climate crisis. The assumptions underlying emissions trading and related climate mitigation mechanisms conceal and help reproduce the capital-climate contradiction and they have not yet been shown to significantly decrease total GHG emissions. It is our contention that they have failed to significantly cut total GHG emissions precisely because they are based on assumptions that misunderstand the capital-climate contradiction. In other words, the ideological assumptions presupposed in emissions trading schemes may be the basis of their failure to reduce total emissions. Finally, by accepting capitalism as a given, market-based solutions demote alternative social futures that may be able to adequately address climate change. Hoffmann's (2011) analysis of the EU ETS and similar schemes summarizes our argument well: 'While well intentioned at first sight, such measures run the risk that they perpetuate the systemic flaws of the system' (p. 13).

The ideological greening of technology via displacement

National climate policies and international climate agreements to reduce carbon emissions, exhibited by Article 10 of the Paris Climate Agreement, often focus on technological fixes that further extend the capitalist logic underpinning carbon emissions rather than the root causes leading to climate change. This represents an ideological, not a pragmatic, reasoned response because, as argued below, techno-optimists displace the technical potential-productive relations contradiction by viewing technology as neutral and disinterested, or, malleable and applicable independent of social context. In other words, techno-optimism in climate policy and its failure to reduce GHG emissions partially results from an assumption that displaces a cause of climate change – the use of technology to increase resource throughput for capital accumulation onto technology itself.

Techno-optimism in environmental thought comes in at least three distinct variants. First, those supporting ecological modernization focus on technology and the shift in the responsibility for environmental outcomes from a command-and-control state to a more central role for the market and other non-state actors (Mol 1995). Second, reformists, namely environmentalists and environmental non-governmental organizations, seek solutions that fit within existing institutions (Demaria et al. 2013) rather than calling for alternatives to the reigning capitalist system. Regarding climate change, this means finding market approaches that facilitate and promote alternative technologies as a means to address climate change, a position captured by market logic that fails to see the futility in a platform predicated on growth-based alternative energy production. Finally, policy elites and corporatists favor a neoliberal approach to governance that privileges entrepreneurial motives to meet societal needs by diminishing or eliminating governmental regulation and oversight to the greatest extent possible. Unlike ecological modernization proponents who see a role for government in a shift to new technology, this perspective seeks to drastically reduce or even eliminate government intervention in the market and instead rely on technological solutions to address climate change that come from the private sector.

Techno-optimists point to alternative energy, energy efficiency, and/or geoengineering as potential advancements that could help ameliorate the negative consequences posed by climate change. Although technological advances theoretically hold the potential to address the challenges posed by climate change, these approaches have limited viability in contemporary societies. By producing energy without fossil fuels, alternative energy appears as the most obvious means by which to reduce GHG emissions globally. However, alternative energy sources such as wind and solar do not necessarily lead to diminished fossil fuel derived emissions, at least at the levels needed to effectively address climate change. York (2012) shows that although alternative energy production has increased, it has not proportionally displaced fossil fuel emissions from energy production. In contrast, on average one unit of alternative energy production displaced only one-quarter of a unit of fossil fuel produced energy and only one-tenth of a unit of fossil fuel generated electricity. This does not bode well given energy demand projections. The US Energy Information Administration projects a 48% increase in global energy

consumption by 2040 and that despite significant investment in renewable energy fossil fuels will supply greater than 75% of total energy (Showstack 2016). As energy demand increases, especially for electricity, renewable energy production would have to grow at a rate faster than any energy technology in history to meet climate stabilization goals (Hook et al. 2012).

An additional problem relates to efficiency and energy use. As William Stanley Jevons identified in the 1860s, increased efficiency (coal-powered steam engines in this case) can lead to an increase in total consumption. This counter-intuitive outcome has come to be known as Jevons paradox. A rebound effect refers to situations in which energy efficiency gains are lost due to increased resource use due to those gains (Santarius 2012). There are different levels of rebound effects. Rebound effects above 100% are termed 'backfire effects' or 'backfires', which means total resource use is higher after the improved efficiency was implemented due to improvements in efficiency. Although the exact mechanisms that lead to this outcome remain unclear (Santarius 2012; Sorrel 2007; York & McGee 2016), many empirical examples confirm the overall trend. These include the findings that countries with high levels of efficiency tend to have higher rates of carbon dioxide emissions, electricity consumption, and energy use (York & McGee 2016; for reviews, see Alcott 2005; Polimini et al. 2008; Santarius 2012). These findings undermine the claims made by techno-optimists that greening technology alone can stabilize the global climate.

Perhaps the strongest manifestations of techno-optimism in proposed climate policy are found in geoengineering strategies, which also fail to address or acknowledge the limitations of technological interventions for addressing climate change. Geoengineering represents a technological approach to alter the Earth's climate system in an attempt to alleviate the impacts of climate change (Boucher et al. 2013). Geoengineering interventions include injecting aerosols (sulfur) into the atmosphere to reflect incoming solar radiation and fertilizing the ocean to sequester carbon, among many others. These and other geoengineering approaches have the potential to contribute to climate stabilization, but they also pose significant risks. For example, injecting sulfur into the atmosphere, modeled on volcanic eruptions, would reduce incoming solar radiation, but it would require continued effort (Keith 2013), has the potential to significantly affect weather patterns and agricultural production (Robock 2008), and could lead to prolonged droughts (Ferraro et al. 2014). More importantly, however, this intervention could prevent actions to reduce GHG emissions. Doing so would reduce the need to reduce GHG emissions, potentially leading to dramatic temperature rise should the intervention stop (Robock et al. 2010). Similarly, iron fertilization in the open oceans could detrimentally affect food webs and ecological functions (Strong et al. 2009) and lead to harmful algal blooms (Allsopp et al. 2007), among other serious risks.

Proponents of renewable energy, energy efficiency, and/or geoengineering have put forth seemingly viable options to address the challenges posed by climate change. These approaches, however, are aligned with the current socio-economic order that created the climate crisis. They are not alternatives to it. The reliance on technology as the solution to the climate change problem comes in different variants, but all reflect an ideological position: they conceal the technical potential-productive relations

contradiction. More specifically, they *displace* the contradiction by presupposing that technology is neutral and disinterested, free to be used and shaped by rational individuals uninfluenced by social-structural context. This assumption is problematic for a number of reasons (for review in environmental context, see Whyte et al. forthcoming). As Marcuse (2011) points out, the ends that technology serve are prepared by the 'pregiven empirical reality' (p. 152), or, 'in line with the prevalent interests in the respective society' (Marcuse 2001: 44). In other words, technology embodies the values and power of the society for which it functions. In world-system and ecological context, Hornborg (1992, 2001, 2009) uses the term 'fetishism' to describe the common illusion of the autonomy of productive technologies, which conceals various socio-ecological processes, such as unequal exchange and the Global North's forgotten dependence on land. Techno-optimists wrongly view old technologies as *the* cause of climate change and can be reformed, rather than interpreting 'dirty' *and* 'green' technologies in social-structural context. The latter allows one to see that the potential of reducing GHG depends on changing the social structures and interests that condition them. For example, the Jevons paradox may partially result from capitalism's aim to maximize profits through two routes: (1) reduce costs of production and (2) produce/sell more, requiring resource use (York & McGee 2016). Improvements in efficiency reduce costs, thereby increasing profits, which are reinvested to expand production, requiring higher rates of resource use.

By displacing the technical potential-productive relations contradiction in this way, climate policy that depends on the greening of technology reproduces existing systems to the exclusion of social alternatives. Focusing on technological solutions in a market-based system omits consideration of both more effective alternatives (discussed below) and, perhaps more importantly, ignores the institutionalized social relations that led to the problems forming in the first place. In all cases, techno-optimist perspectives implicitly or explicitly rely on the market for solutions. Even if proponents are unaware, climate policy that depends on green technology represents a continuation of a larger project to serve capitalist interests. It does so by relying on technology rather than social change to reduce carbon emissions, thereby allowing the fossil-fuel-based economy to continue unfettered. Technological solutions devised to alter social processes that lead to reduced emissions hold great potential (Keary 2016) but simply focusing on technology as the solution to climate change represents an ideological rather than a practical solution. Few proponents of renewable energy, energy efficiency, and/or geoengineering prioritize total energy reduction or technologies that might guide social behaviors in a new direction. Instead, they focus on techno-fixes designed to increase economic growth and hold assumptions that displace the technical potential-productive relations contradiction. This represents an ideological approach orchestrated to fit 'solutions' into an existing economic paradigm rather than looking for effective, long-term alternatives.

The ideological greening of growth via dilution

Green growth – alternatively, the 'green economy' (UNEP 2011) or the 'green transition' (AASA 2011) – is a recent and increasingly popular (Jacobs 2013) addition to climate

policy frameworks. Green growth is distinct from sustainable development as it casts off notions of social justice, democratization, and traditional regulation of industry central to the sustainable development narrative (Dale et al. 2016). Along with the belief that environmental pressure and GHG emissions can be decoupled from economic growth – familiar in similar ideas such as ecological modernization theory, the environmental Kuznets curve, and weak sustainability theories – the more distinctive claim of green growth is that there are a series of 'synergies' between environmental protection and economic growth, or, economic capital can *benefit from* the protection of 'natural capital' (Bowen & Frankhauser 2011; Hallegatte et al. 2011; Jacobs 2013; Jänicke 2012; Mathews 2012). Highlighting the economic benefits of environmental protection has gained traction through reports and recommendations from a number of international institutions: the EU Commission (2010), the Association of Academies of Sciences in Asia (AASA 2011), the United Nations Environmental Programme (UNEP 2011), the Organization for Economic Co-operation and Development (OECD) (e.g. 2011), and the World Bank (e.g. 2012) (for summary of some of these major reports, see Jänicke 2012). We argue that the green growth strategy *dilutes* both the capital-climate and technical potential-productive relations contradictions.

Green growth is believed to be possible through three policy mechanisms: (1) green stimulus packages, (2) market-corrective or price-based policies (discussed in section 'The ideological greening of markets via misunderstanding'), and (3) green industrial innovation (discussed in section 'The ideological greening of technology via displacement') (Jacobs 2013; for overlapping green growth strategy typologies, see Bowen & Frankhauser 2011; Hallegatte et al. 2011; OECD 2011). Green Keynesian stimuluses in environmental industries were adopted by a number of national governments following the 2008 financial crisis and recession (Jacobs 2013). The argument is that all three policy mechanisms are good for the economy and the climate. In short, '[g]reen growth is about making growth processes resource-efficient, cleaner, and more resilient without necessarily slowing them' (Hallegatte et al. 2011: 3). When compared to other climate policy frameworks, what differentiates green growth is its ability to draw from non-classical economic perspectives (e.g. Keynesian) (Bowen & Frankhauser 2011) and, as stressed above, framing environmental protection as an economic opportunity, rather than an economic burden. Additionally, green growth thinkers are less naïve than some climate change economists, from an ecological perspective: they argue for urgent and immediate action (Hallegatte et al. 2011; Jacobs 2013; OECD 2011) and 'moderate' growth rates (Jänicke 2012; UNEP 2011).

Despite its unique and promising features as a policy framework, green growth has been met with criticisms (e.g. Dale 2015; Hoffmann 2011; Santarius 2012; Yun 2010; for collection of leading critics, see Dale et al. 2016). In the context of climate change, Hoffmann (2011) provides a number of reasons that green growth is an 'illusion' of 'false hopes'. Greening growth at the *scale* and *pace* needed to limit global warming to 2°C by 2050 is unfeasible for a number of reasons, including (1) carbon intensity would need to be reduced by at least 21 times (assuming 2% gross domestic product (GDP) increases per year, a low estimate) and up to 128 times (assuming 2% GDP increases per year coupled with developing countries 'catching up' to developed countries) – reductions that seem unfeasible through green growth mechanisms; (2) efficiency increases in a given developed country

often result from outsourcing environmentally destructive industries (cf. Santarius 2012); (3) it is highly unlikely that renewable energy will completely displace fossil fuels (cf. York 2012); (4) consumption habits will need to be radically altered; and (5) increased efficiency may increase the consumption of fossil fuel resources (i.e. the Jevons paradox discussed above; cf. Santarius 2012). Furthermore, since the implementation of South Korea's National Strategy for Green Growth – *the* case study of green growth policy (Mathews 2012) – carbon dioxide emissions and energy use have increased (Bluemling & Yun 2016: 125; Gunderson & Yun 2017).

These limitations of green growth stem from its masking over of the capital-climate *and* the technical potential-productive relations contradictions. Green growth is the union of the ideological greening of markets and technology, coupled with a supposedly environmentally conscious and exceedingly technocratic Keynesianism. Thus, all of the criticisms developed in the previous two sections also apply to the green growth strategy. It is 'sustainable development without the tears' (Dale et al. 2016: 6) and ecological modernization without appeals to other modern values beyond growth through technological progress and market expansion. Above, we highlighted Larrain's (1982) concept of *dilution* as a form of contradiction concealment: a contradiction is recognized but there is an attempt to weaken the contradiction by reconciling irreconcilable elements. The common example of contradiction dilution in Marxist scholarship is the continually undercut and disappointed attempt by labor to improve relations with capital (i.e. to find 'win–win' policies). The claim is that these policies often fail to make long-lasting and significant changes, with capital usually triumphant because the interests of labor and capital are irreconcilable. We find a similar situation with the green growth strategy, which recognizes that there is a tension between capital and the climate, but attempts to *conceptually* weaken the contradiction by reconciling elements that are irreconcilable in reality (i.e. continued economic growth and adequate reduction in GHG emissions). Furthermore, it recognizes that the technical potential for a sustainable society exists, yet attempts to sustain the institutionalized social relations that block this potential. The very notion of 'green growth' epitomizes 'a solution in the mind to contradictions which cannot be solved in practice; it is the necessary projection in consciousness of man's practical inabilities', that is, an ideology (Larrain 1979: 46).

Alternatives to ideological climate policy

As argued above, proposed solutions to climate change through the greening of markets, technology, and growth fail to address the systemic drivers of GHG emissions and therefore represent false solutions that mask the more fundamental changes necessary for climate mitigation. These false solutions defend the status quo by proposing minor tweaks to the current system rather than rethinking social priorities and reconfiguring socioeconomic relationships. Capital accumulation remains the primary goal and significant resources have been invested to maintain this goal even as scientific support for climate mitigation has intensified (Dunlap & McCright 2015). In addition to those protecting their financial interests, other citizens fear the prospect of social transformation and turn toward ideologies that allow them to avoid confronting problems and the systemic

changes needed to address them. System justification theory posits that people rationalize the way things are in ways that can deter the changes necessary to address systemic issues (Feygina et al. 2010). In the case of climate change, the greening of markets, technology, and growth represent a safer response to climate change than degrowth (discussed below) or other approaches that do not prioritize profitability.

The challenge remains getting people to cast off ideologies that prevent change. Following from the 'negative' conception of ideology outlined above, the aim should not be to merely replace one ideology with another (e.g. replacing 'bourgeois ideology' with 'proletarian ideology'), but to get rid of ideas and reproductive practices that conceal contradictions. With the aim of helping to accomplish this task, without the arrogant belief that we are free from ideological assumptions – because to assume that one holds no ideological beliefs is a clear sign of ideological trappings (Harvey 1973: 18) – we identify paths to alternative social futures that we think directly confront and could potentially overcome the capital-climate and technical potential-productive relations contradictions. If the identified paths, degrowth and Marcuse's 'new' technology, overcome these two systemic socio-ecological contradictions, one could dub them 'effective' paths in climate policy. Because degrowth and Marcuse's 'new' technology are both antithetical to the capitalist social order and, thus, elite interests, our arguments rely on explicit normative and political commitments. To accomplish these tasks, we first explore the work of Therborn (1980) and other scholars who draw form Marx and Gramsci to understand ideology and social change (Levy & Egan 2003; Levy & Spicer 2013; Nyberg et al. 2013; Wright 2010, 2015). We examine how ideological transformation might take place and then propose potential pathways to overcome the capital-climate contradiction (degrowth) and the technical potential-productive relations contradiction (Marcuse's 'new' technology).

How to overcome ideology

While we have adopted a negative definition of ideology in this article and Therborn (1980) uses a more general definition of ideology – which includes 'everyday notions and "experience" and elaborate intellectual doctrines, both the "consciousness" of social actors and the institutionalized thought-systems and discourses of a given society' (p. 2) – insights from his work still apply. Therborn's conception of transformation involves the replacement of one ideology with a competing ideology. However, we can also apply his work to the negative definition of ideology – ideologies that conceal systemic contradictions (Larrain 1979). Ideologies can be cast off if people realize their historically contingent and contradiction-concealing qualities. We extend this reasoning to explore the following questions: What does it take for an ideology to be disregarded? What will it take for the greening of markets, technology, and growth to be seen as false promises that mask the need for radical socio-economic transformation?

In his book *The Ideology of Power and the Power of Ideology*, Therborn (1980) describes a 'logic of change' to ideological transformation:

> In order to become committed to changing something, one must first get to know that it exists, then make up one's mind whether it is good that it exists. And before deciding to do something about a bad state of affairs, one must first be convinced that there is some chance of actually changing it. (p. 19)

In this case, individuals would need to become conscious of the fact that the 'green' ideologies described above are concealing something and what that something is. Then, individuals would have to decide that this concealment was undesirable, for instance, by causing more GHG emissions and more climate change. Lastly, to cast off the greened ideologies, individuals would have to recognize that another system and social order is possible, that we can fundamentally address climate change as well as a host of other social issues through alternative socio-economic relationships. These steps are explored further below.

Regarding the casting off of green markets, technology, and growth as viable solutions to climate change, we see an uphill battle toward ideological transformation. Conservative think tanks and media outlets, or what McCright and Dunlap (2010) call 'anti-reflexivity' forces, have adopted multiple strategies to hinder responses to climate change that not only conceal the underlying contradictions but deny that climate change is occurring at all, deny that it is caused by humans, and deny the seriousness of the issue (for review, see Dunlap & McCright 2015). As a result of these efforts, less than half of the US population believes in anthropogenic climate change and it continues to rank as one of the lowest national priorities (Hart et al. 2015). If people do not perceive climate change to be real or to be a threat, they are unlikely to dig deeper to understand root causes, contradictions, and debunk the ideologies that conceal these contradictions. For example, even the false 'win–win' solutions proposed through green technology face considerable resistance: powerful political and economic interests constrain changes in infrastructure and technology (DeCicco & Mark 1998; Viitanen & Kingston 2014). More radical changes, that address the root causes of climate change, will face increasing resistance. This suggests that it is unlikely that the false promises of green markets, technology, and growth will be exposed in the near future. In this case, there are considerable challenges to the first and second conditions for ideological transformation identified by Therborn (1980). We are far from having widespread recognition of the false promises of green markets, technology, and growth, and we are therefore also far from a recognition that these approaches are detrimental in that they conceal the underlying contradictions and put off the real changes necessary to address climate change.

The last condition for change relates to the ability for people to recognize that there is a possibility for change, that another system is possible, and that we can fundamentally alter the social order in a way that addresses the root causes of climate change. A growing number of scholars and activists recognize that we cannot address climate change without significantly altering the socio-economic system (e.g. Foster 2011; Kallis et al. 2012; Klein 2014; Li 2013; Schwartzman 2014). However, this remains a fringe and 'radical' perspective in the eyes of most US citizens. Many people do not see that alternative socio-economic systems are possible. A critical strategy of the neoliberal capitalist movement has been to extinguish any notion that other systems are possible; therefore, even if contradictions are revealed, a lack of knowledge about alternatives represents a significant barrier to change (Morgan 2013). The underlying belief is as follows: if capitalism ends, society ends. As put by philosopher Slavoj Žižek (2010),

> For us, it's easier to imagine the end of the world than serious social change … Maybe it's time to reverse our concept of what is possible and what isn't; maybe we should accept the impossibility of omnipotent immortality and consider the possibility of radical social change.

According to Gibson-Graham (2008), making post-capitalist economic relationships more widely known is a critical step toward convincing the public that another social order is possible. Without this exposure and knowledge, people will continue to justify the current system and propose shallow solutions that will fail to adequately address climate change.

The above application of Therborn (1980) focuses on ideological transformation among individuals in the general public and paints a rather bleak picture regarding the widespread social changes needed to address climate change. However, climate change politics is made up of more than individuals. Other scholars who draw from Marx and Gramsci remind us that groups of citizens have already mobilized in strategic efforts against the corporate-state-fossil fuel coalitions that continue to deter responses to climate change. Drawing from Gramsci, Levy and Egan (2003) adopt a strategic notion of power and illustrate how coalitions of industrial and corporate actors respond to and defend against challenges to their hegemonic position. These challenges have continued and intensified. Nyberg et al. (2013) also draw from Gramsci to illustrate corporate strategies to respond to hegemonic challenges. As depicted by Klein (2014), political activists are building momentum through blocking fossil fuel extraction and transportation endeavors and pressuring institutions to withdraw financial investments in fossil fuel companies. Climate change movements increasingly mirror Gramsci's (1971) depiction of political warfare with strategic maneuvers and counter-maneuvers. As these movements intensify, the 'green' ideologies examined here are likely to face increased scrutiny and the general public may be exposed to new truths about capitalism and climate change.

As argued by Klein (2014), the battle over climate change is directly linked to the battle over capitalism. While detailing how to move past a capitalist social order is beyond the scope of this article, we will state that a strategy along multiple fronts is needed. We agree with Wright (2010, 2015) that the best hope for combating capitalism is to both create alternatives within the cracks and sidelines of the current system while also working for structural changes that move us toward a post-capitalist social order. Gibson-Graham (2008) and Alperovitz and Speth (2015) argue that a critical step toward ideological transformation is widespread awareness of alternative (post-capitalist) economic relationships, such as those in worker-owned cooperatives, community supported agriculture, and publicly owned utilities. In addition, anti-capitalists need to focus on eroding capitalism at the top through challenging and changing state policies and priorities (Wright 2010, 2015). As a guiding principle, we focus on degrowth (see below). In this way, our proposed solutions go further than Klein (2014) and others who offer what resembles a form of green Keynesianism to address climate change.

Lastly, as we face the impacts of climate change, will an increase in environmental crises result in the abandonment of the 'green' ideologies that mask inherent problems with capitalism? Both Gramsci and Marx discuss how crises can, though do not necessarily, stimulate radical political change. Hegemony becomes fragile and contested and crises can open up pathways for radical transformation. Therborn (1980: 34) also argues that all material conditions are a determinant of ideological change. This suggests that when the biophysical environment changes, ideology changes as well. As climatic conditions further intensify, society will be faced with repeated crises including increased storms, severe droughts, unprecedented heat waves, catastrophic floods and their impacts on transportation, food production, and housing (National Climate Assessment Report

2014). However, in this case, there is a significant temporal gap between the crises society faces and the causes of the crises. As emissions of GHGs today have impacts well into the future (IPCC 2013), effective responses to climate change require forethought and advanced execution. When environmental conditions have changed enough for people to first realize that climate change is real and then to realize that current strategies proposed to address climate change are insufficient, it will likely be too late to adopt the systemic changes necessary. Strategies that have hindered policy responses to address climate change may result in the eventual dismissal of any mitigation actions as they are deemed 'too little too late' and there becomes a general acceptance of climate change adaptation and, perhaps, geoengineering *rather than* mitigation. In the case of climate change, social movements cannot afford to wait for more crises to stimulate a radical response to climate change.

Degrowth

Degrowth represents a movement that challenges the ideological positions embedded in growth-oriented politics and economics. The term emerged in France in the 1970s and activist groups in the country used it prominently beginning in 2001 (Baykan 2007) and it has taken on greater importance and influence since. Rather than an economic paradigm or ideology, Demaria et al. (2013) argue that 'degrowth has now become a confluence point where streams of critical ideas and political action converge' (p. 193). Whereas market-corrective measures, techno-optimism, and green growth represent capitalist approaches, degrowth represents a critique of capitalism and takes a decidedly non-capitalist approach to addressing societal problems (Latouche 2012). Latouche (2009) characterizes western development as a mental construct, one taken up by the global community that has had disastrous consequences. Degrowth challenges the supremacy of the growth mindset, whether supposedly green or 'brown', by calling for intentional economic downscaling to create a global society that no longer exceeds biophysical boundaries (Kallis 2011). Some have criticized degrowth (e.g. Schwartzman 2012), including a suggestion that alternative energy will require continued growth to meet climate demands (Schwartzman 2014) as well as pushing the degrowth movement to recognize that it is currently only overdeveloped countries that must 'deaccumulate' and to align itself with an explicitly socialist agenda (Foster 2011). Although alternative energy will certainly play an important role in the future (see next subsection), degrowth focuses instead on constraining economic expansion and fitting energy production into a new set of social relations. Furthermore, degrowth thinkers recognize that the material economic well-being of developing populations would need to increase while simultaneously shrinking the global economy by at least a third (Assadourian 2012).

Degrowth rests on the reality that growth requires continued energy and material throughput predicated on fossil fuels. As such, current approaches promoting alternative energy sources still perpetuates growth, with severe consequences for society and the environment. It also recognizes that the social promises of growth have not materialized. Easterlin et al. (2010), among others, have shown that growth that goes beyond satisfying basic needs does not lead to happiness (for similar results concerning economic growth and human well-being per unit of environmental pressure, see Dietz et al. 2012). Degrowth then could lead to less material throughput and consumption while

simultaneously increasing well-being. However, an economic shift that leads to equalized wealth distribution and a more prominent focus on public services through intentional degrowth could in the short term lead to diminished well-being and happiness. Matthey (2010) suggests that the real and perceived perspectives of such a shift depend on the aspirations people have and how they view the equality embedded in such a transition. Despite various potential outcomes, Trainer (2012) argues that global society has over-appropriated resources and that a transition away from growth is inevitable. In order to minimize negative consequences, the transition will require implementing policies to bring about what Martinez-Alier (2009) calls 'socially sustainable economic degrowth' to ensure stability and well-being.

New technology

Degrowing the economy would not be enough to achieve effective climate mitigation. Changes in the social ethos and technological changes would also be necessary. Given that the greening of technology will not address the root causes of climate change, is there a role for technology to address climate change in a post-capitalist society? To explore this question, we draw from the work of Marcuse. Marcuse (1964, 1972) argues that technologies can help society and reduce environmental pressure if they are freed from their role in domination. A harmonious relationship between technology and nature is predicated on a new social order that abandons the notion of domination and growth without limits. This new society would use technology to serve the goals of social welfare and environmental sustainability, not for blind economic gain. Marcuse explained that a new science and technology apart from capitalist imperatives could support the protection of nature rather than its exploitation. As argued by Marx (e.g. 1977: 562f, 1978: 632), technology remains embedded in social projects with various goals. These goals may include improving social and ecological welfare. Technologies already exist that foster a more harmonious relationship between humans and nature, including wind and solar energy. In many cases, these transformative technologies remain hindered by political and economic power relations, but could become widely adopted in a society that has abandoned the doctrine of economic growth (e.g. York & Clark 2010: 491f; Foster 2002: 101). A social order with a new set of substantive goals (Marcuse 1964: 232) could radically change how we use technology and its social and ecological impacts.

Related to climate change, new technologies could be adopted, not for economic gain, but specifically to reduce GHG emissions and improve social and ecological conditions. These would likely include innovations in wind and solar energy as well as technologies that support short- and long-distance public transportation using minimal resources. These innovations would need to emerge in an alternative social order predicated on a new economy and a new democratic system, reconfiguring relationships between people and the planet (Klein 2014). For example, Bollier (2014) proposes an energy model that is democratically operated by local communities as cooperatives. Ideally, these publicly owned and operated utilities would use innovative wind and solar technologies and local governance would improve public support and encourage conservation. Such models can already be seen in some parts of Germany and Denmark (Klein 2014). Larger energy grids and long-distance public transportation systems could be funded, designed, and

coordinated by federal governments. Local governments could create systems of bike lanes, subways, and streetcars that are accessible by all. Societies could phase out the use of individual vehicles and innovative transit systems – including railways and light rail – would replace highways and roads. The industrial agriculture system would also need to be transformed into low-input, ecologically based local systems that address GHG emissions related to fertilizer use and long-distance transportation (Klein 2014). Technology can play a critical role in these changes. Instead of a tool used for maximizing profits, technology can be used as a tool to reduce resource use. Technologies can be designed not to support the fastest, easiest, or most profitable way to do something, but designed specifically to reduce consumption and GHG emissions.

Marcuse (1964, 1972) argued that a harmonious relationship with technology is predicated on a cultural shift involving a change in ethos. In accord with claims made in ecological economics (e.g. Herman Daly and Peter Victor), we need a new worldview that takes planetary boundaries into account if we are to address climate change. A new social order must operate under an understanding of limits, restraint, and downsizing. Mike Davis (2007) reminds us that a new ethos based on these principles is not impossible and offers an example from the recent past. During World War II, local food systems emerged in the form of community and kitchen gardens. Rations on gasoline and rubber reduced the use of automobiles and encouraged public transit and bicycles as well as the development of ride sharing networks. Many citizens followed principles of buying only what was needed and reducing resource use to support the war effort. Davis (2007) shows that, even in the United States, where consumerism and supersizing has run rampant, society can be quickly transformed to reduce consumption on a widespread scale. While addressing climate change will require an even greater cultural transformation, Davis' (2007) example illustrates that society can adopt conservation doctrines. However, a new system of values based on restraint or what Levy and Spicer (2013) call the 'sustainable lifestyles imaginary' faces many obstacles, as most Americans continue to have a 'more is better' perspective on consumption. Broader value regimes must shift to support new lifestyles based on reduced consumption (Levy & Spicer 2013). In a new society based on the principles of biophysical limits and minimal resource use, technological innovations in energy and transportation can be used as important tools to reduce GHG emissions and harmonize relationship between humans and nature.

Conclusion

In the context of climate change policy, especially the 2015 Paris Climate Agreement, this project synthesizes and develops critiques of the possibility of greening capitalism. To advance this critique, an explicit 'negative' theory of ideology is adopted: ideas that conceal contradictions through the reification and/or legitimation of the existing order. Common climate change mitigation policy frameworks – the 'greening' of markets (market-corrective measures), technology (alternative energy, energy efficiency, and geoengineering), and growth (the green growth strategy) – are shown to conceal one or both of the two systemic socio-ecological contradictions: (1) a contradiction between capital's growth-dependence and the degrading effects expansionistic production has on the climate (the 'capital-climate contradiction') and (2) a contradiction between the potential of using a 'green' technological infrastructure to aid in emissions reductions and the

institutionalized social relations that obstruct this technical potential (the 'technical potential-productive relations contradiction'). Market-corrective climate policy *misunderstands* the capital-climate contradiction. Techno-optimism *displaces* the technical potential-productive relations contradiction. The green growth strategy conceptually *dilutes* both systemic socio-ecological contradictions. After proposing a way in which societies might move out of the ideological trappings green markets, technology, and growth, we propose two alternatives: degrowth and the 'new' technology outlined by Marcuse.

A likely critical and reasonable reply to our thesis is as follows: Acknowledging that current climate mitigation policies are limited, short-sighted, and so on, but maintaining that these strategies are the first steps to something better, that they are better-than-nothing, and/or are necessarily limited due to vested interests. This reply will then ask, 'Is it not more ideological to criticize these limited strategies than to embrace them?' We agree that almost any socially sustainable measure to reduce GHG emissions is better than not reducing GHG emissions. The greening of markets, technology, and growth may be better than business as usual projections – although we highlight cases above when these mechanisms may have actually increased emissions (e.g. backfires in energy efficiency) or may be too risky (e.g. geoengineering) – but this 'realistic' and 'pragmatic' thinking too is one of the reasons why these policies are ideological: they block out social alternatives to the contradictory reality that created the climate crisis. Arguing that the greening of markets, technology, and growth are better-than-nothing is simultaneously implying that there is no real social alternative. The latter may be true in terms of political feasibility at this time. Yet, the 'first step' in making social alternatives politically feasible is to expose the ideologies that implicitly dismiss social alternatives.

Our aim is not to put forth culturalist or psychological explanations for climate change, but to identify ideological forms and content in prevalent climate policies that *reproduce* the conditions that cause climate change. Our central thesis is that attempts to 'green' the very techniques and institutions that brought about the climate crisis will remain ineffective, conceal systemic contradictions, and continue to reproduce the same social order that has caused climate change. While real economic growth, real techniques used in the service of capital, and real commodification are primary underlying drivers of climate change, our claim is that the ideological content of prevalent climate policy mechanisms reproduce ecological destruction by concealing systemic contradictions and legitimating and reifying the current social order. Furthermore, they restrict our horizon of thinking about alternatives to capitalism. Only through increased exposure, awareness, and acceptance of alternatives to a capitalist social order will society transform to respect ecological limitations and use technology in new ways that can dramatically reduce resource use and GHG emissions.

Note

1. It is worth noting, especially in an article concerning ideology, that the two contradictions described are neither eternal nor objectively given in any naïve sense. They result from, as Vogel (2015: chapter 2) recently puts it, the *literal* social construction of the environment by humans, shaping both the objective world and perceptions of it – a view of human practice and knowledge first developed by Hegel, Marx, and the Frankfurt School. Indeed, the only way in which one can identify socio-ecological contradictions and their ideological masking is with the assumption that human societies actively shape and reshape the environment

(Gunderson 2016: 65f). This claim does not imply that one should discard critical approaches to ontological realism, but does mean that the prospect of attaining an unmediated access to the objective laws of history, for example, is illusionary.

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