

# Decarbonizing the downturn: Addressing climate change in an age of stagnation

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## Abstract

Meeting the Paris climate goals requires the global economy's urgent decarbonization. States and intergovernmental bodies insist that this should be pursued via a tremendous spike in private investment in renewable power – encouraged and coordinated by states. However, this renewable investment boom will have to swim against the current of the stagnation of the world economy since the 1970s, characterized by weak rates of investment and growth. Undertaking decarbonization in this context presents unique political economy dilemmas. Firstly, although slow growth helps to reduce carbon emissions by lowering energy use, it simultaneously impedes energy efficiency gains. Secondly, the stagnant state of global industry militates against its adoption of expensive decarbonized industrial processes. Thirdly, while most renewable power sources have failed to attract sufficient investment, those that have expanded rapidly – particularly solar photovoltaic – have tended to exhaust their growth potential due to falling prices and profitability. Finally, economic stagnation has destabilized political institutions, exerting pressures on governments to stimulate growth regardless of the environmental implications. States must navigate these intractable dilemmas as they strategize to decarbonize the downturn.

## Keywords

Climate change, decarbonization, neoliberalism, stagnation, capitalism

## Introduction

From states to intergovernmental agencies to business groups, a consensus is emerging that avoiding catastrophic global warming will require the decarbonization of the world economy (Newell, 2021). This means replacing fossil fuels with renewable energy across core human activities, including power, industry, transport, buildings, and agriculture. Growing recognition of the immensity of this challenge has provoked debate on the relationship between decarbonization and

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economic growth (Buch-Hansen and Carstensen, 2021). ‘Green growth’ advocates – including liberal international organizations like the World Bank and radical Green New Deal proponents – insist that growth and decarbonization can be made to positively reinforce one another (World Bank, 2012; Barbier, 2010). High growth could provide more funds for green investments, while such investments could provide socially beneficial growth opportunities. Advocates of ‘degrowth’, however, contend that there is simply no evidence that economic growth and carbon emissions can be sufficiently decoupled in time to avert climate disaster (Hickel and Kallis, 2020). Instead, growth must be deprioritized and material throughput scaled down to keep society safely within earth system boundaries (D’Alisa et al., 2015). This debate has acquired a political dimension too. Massively expanding renewable investment, green growthers argue, is more politically saleable if the overall economy is growing than if this investment comes at the expense of other projects or people’s incomes (Pollin, 2019). Critics of green growth counter that its promise of all things to all parties is evidence of its unseriousness as a means to tackle the profound dilemmas presented by planetary heating. Degrowth, in contrast, would entail genuine political transformation – redistributing wealth, expanding the provision of decommodified social goods, and reducing working time (Liegey and Nelson, 2020).

While this debate has been fruitful, an arguably more pressing puzzle has gained less attention: regardless of whether we embrace or reject economic growth, our global economy has *in practice* become mired in a state of long-term stagnation. Since the 1970s, the world economy has displayed relatively weak profitability, investment, productivity, and GDP growth (Brenner, 2006; Schwartz, 2021). This amounts to a kind of ‘involuntary degrowth’ (Bonaiuti, 2018), or at least slowing growth. Although this phenomenon has been discussed only briefly in green growth and degrowth literature (Pollin, 2019; Mastini et al., 2021; D’Alisa et al., 2015), certain scholars have begun to explore the interaction between environmental destabilization and economic malaise (Klitgaard and Krall, 2012; Jackson, 2019; Albert, 2020). This article contributes to this emerging research area by bringing political economy literatures on decarbonization and economic stagnation into conversation with one another, and by offering a novel analysis of the quandaries that states face at this conjuncture. Contrary to accounts that treat economic growth voluntaristically, as a goal that can be prioritized or deprioritized, I argue that growth is instead an unconscious effect of the operation of capitalism – a system with an historical tendency towards waning dynamism. Addressing climate change at this moment in capitalism’s development means reckoning with a system that is entirely reliant on growth and yet increasingly unable to deliver growth at previous levels without extraordinary political intervention. This is the challenge of decarbonizing the downturn, and it entails a set of unique dilemmas for states that I will explore in this article.

The conventional wisdom, promoted by governments and international organizations, dictates that decarbonization must be led and coordinated by states. Vogler (2016: 5) writes that states are ‘the only agents possessing sufficient capability and legitimacy to orchestrate the regulatory action necessary to sustain the global atmospheric commons’. Yet the conventional wisdom also understands that states’ key task is to guide the private capitalist economy to disinvest from carbon-intensive activities and funnel massive investment into carbon-neutral activities (IEA, 2021; IRENA, 2021). In other words, successful decarbonization will require an unprecedented transformation in and aggregate expansion of private investment, brought about by effective state policies. However, such a green investment boom will have to reverse contemporary economic stagnation. There is no consensus on the causes of this slowdown, yet I argue that the most compelling explanations are those Marxist accounts that trace it to capitalism’s contradictory dynamics, whereby competition to boost labour productivity inadvertently generates overproduction, falling prices, and declining profitability. If correct, this suggests that stagnation is an

intractable outcome of capitalist development, and thus that states' decarbonization initiatives will be required to negotiate the challenges that it presents.

In this article, I explore key political economy dilemmas generated by the pursuit of decarbonization in such conditions. In one respect, stagnation helps to reduce carbon emissions, because slower growth translates into lower energy usage. However, economic malaise also impedes new investment to raise energy efficiency. Further, the stagnant conditions of polluting industries like steel and automobiles hinder their decarbonization by discouraging expensive green retrofitting. The case of renewable power is bifurcated. Most renewable power sources have simply not been able to attract significant investment. One positive development has been the expansion of solar photovoltaic (PV) production, greatly lowering renewable electricity prices. Yet this sector too has followed the pattern of much of global industry: production has risen, prices have fallen, and profits have eroded. Solar PV is now characterized by serious overcapacity, endangering its growth at this vital moment. Lastly, stagnation threatens the very ambition of governments to pursue decarbonization, as it destabilizes social compromises, creating pressure on policy-makers to restore growth at any cost.

This is the contradictory terrain that states must traverse as they seek to decarbonize the downturn. To the degree that mainstream decarbonization strategies continue to founder on the rocks of economic stagnation, and as the climate catastrophe intensifies, states are likely to undertake more interventionist measures to propel the energy transition and manage the social fallout of global warming. Such state measures can assume a progressive or regressive bent. It is thus imperative to exploit the space created by these political transgressions to discuss and construct mechanisms of democratic economic planning through which to pursue rapid and just decarbonization – planning that would not seek to bolster or redirect private market activity, but replace it.

### *An unrevolutionary revolution*

Within the green growth vision, everything must change but our social relations. Human infrastructure must be revolutionized along renewable lines, without disturbing the structure of capitalist society. As this section explores, pursuing decarbonization in this manner will require an enormous mobilization of private investment – the possibility of which is threatened by contemporary economic stagnation.

The 2015 Paris Agreement was notable for its relative ambition. States agreed to aim to hold global temperatures 'well below' 2°C above pre-industrial levels, with an aspirational target of 1.5°C (Held and Rogers, 2018: 532). In 2022, the Intergovernmental Panel on Climate Change (IPCC, 2022) stated that in order to limit warming to 1.5°C – with little or no overshoot – global net anthropogenic CO<sub>2</sub> emissions must peak by 2025, decline to 43% of their 2019 level by 2030, and reach zero by the early 2050s. Practically, this means that the global economy must undergo rapid and near-total decarbonization. The world's energy sector, which emitted 45% of global CO<sub>2</sub> over the last decade, must swap fossil fuels for renewable power. Global industry is responsible for 23% of CO<sub>2</sub> emissions. Industrial processes must therefore be rapidly transformed in line with climate imperatives. Transport, from roads to shipping to aviation, emits a further 22.5% of global CO<sub>2</sub>. This sector must replace internal combustion engines with electric motors and discover a solution for hard-to-electrify transportation. A final 10% of CO<sub>2</sub> emissions comes from buildings, agriculture, fishing, militaries, and other activities, and thus avoiding climate catastrophe implies redesigning our basic systems of food and shelter provision (Peters et al., 2020: 4). For climate transition models that assume continuing economic growth, this shift must be accompanied by two

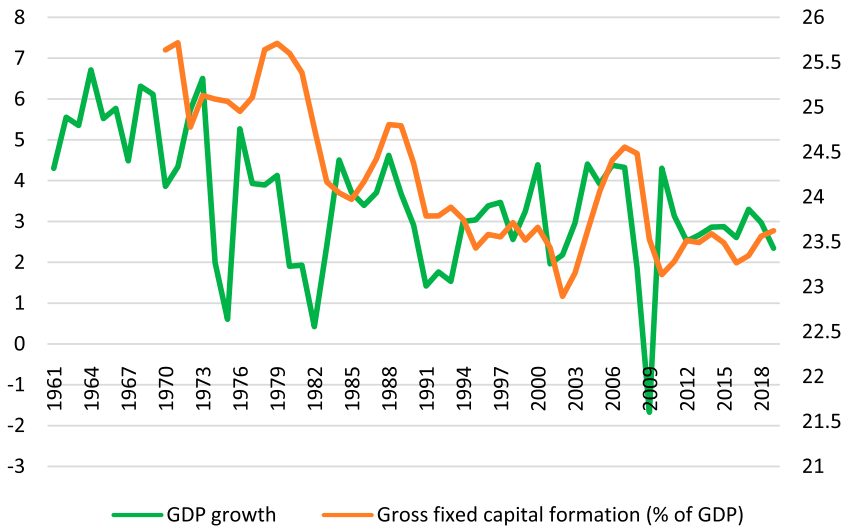
further processes. The first is a historically unprecedented increase in the rate of energy efficiency gains that will lower overall energy use (Brockway et al., 2021). The second is the capture and sequestration of CO<sub>2</sub> through carbon capture and negative emissions technologies (Low and Schafer, 2020).

The IPCC (2018: 45) could not be accused of exaggeration, then, when it observed that limiting planetary warming required ‘fundamental societal and systems transformations’. More appropriate is the stark language of the German Advisory Council on Climate Change, which compared the necessary changes with the two greatest shifts in human civilization to date, namely the Neolithic transition to settled agriculture and the industrial revolution (Newell, 2021: 13). Yet unlike these previous world-historic changes in how humans have harnessed the sun’s energy, the coming revolution must not be a revolution in social relations (Lewis and Maslin, 2018). There is universal implicit agreement amongst states and intergovernmental bodies that this third great transformation must leave capitalism intact. We are to completely reshape our relationship to energy while navigating the social trip wires of private property, market competition, and the profit imperative.

With a reorganization of social relations ruled out, this energy transition must be achieved chiefly through an enormous reallocation of private investment – coaxed and directed by states. Such a shift is already underway. In 2018, global investment in new renewable power was three times larger than investment in new fossil fuel power (IRENA, 2020a: 4). However, both current levels of investment and the future investment commitments made by governments and companies ‘fall far short of what would be needed to limit world temperature increases to less than 2 degrees Celsius’ (Frankfurt School-UNEP Centre/BNEF, 2020: 11). Estimates of the volume of investment required to achieve a timely green transition are speculative, but recent reports by the International Renewable Energy Agency (IRENA, 2021) and the International Energy Agency (IEA, 2021) have come to similar conclusions. Much of the necessary investment in renewables can be redirected from existing fossil fuel investment, but additionally there must be an aggregate expansion in overall energy investment. While annual expenditure on the entire global energy system has hovered around US\$1.8 trillion for the last 5 years, this must more than double to between US\$4.4–5 trillion annually until 2050. A 2022 McKinsey report takes a broader approach, estimating the cost of reaching net zero in terms of the required capital investment across seven core sectors: power, industry, mobility, buildings, agriculture, forestry, and waste. The figure arrived at is \$9.2 trillion a year until 2050 – equal to almost 10% of global GDP in 2021 (Krishnan et al., 2022).

A potential problem with these models is that they rely on unprecedented increases in energy efficiency without discussion of possible ‘rebound effects’, whereby gains in energy efficiency lead to *rising* rather than falling energy consumption due to falling energy prices that stimulate energy demand (Smil, 2017: 14). The scale of such rebound effects is debated, yet recent studies indicate that ‘economy-wide rebound effects may erode more than half of the energy savings from improved energy efficiency’ (Brockway et al., 2021: 11). Further, such models rely upon carbon capture and negative emissions technologies, including bioenergy with carbon capture and storage. Many such technologies exist ‘only at the pilot stage’, and thus scientists and campaigners warn against their inclusion in intergovernmental agencies’ climate models (Low and Schafer, 2020: 1). If such energy efficiency and carbon capture targets prove too optimistic, the required annual investment in renewables could be far larger than currently estimated.

How can this ‘unparalleled clean energy investment boom’ be brought about (IEA, 2021: 22)? Various strategies to invigorate private investment have been proposed. These include efforts to de-risk green investments through public subsidies; the creation of green bonds and other renewable investment funding instruments; calls for central banks to make the cost of doing business cheaper



**Figure 1.** Global GDP growth and gross fixed capital formation as a share of GDP. Author's constructions from the World Bank's data series, available at [data.worldbank.org](https://data.worldbank.org).

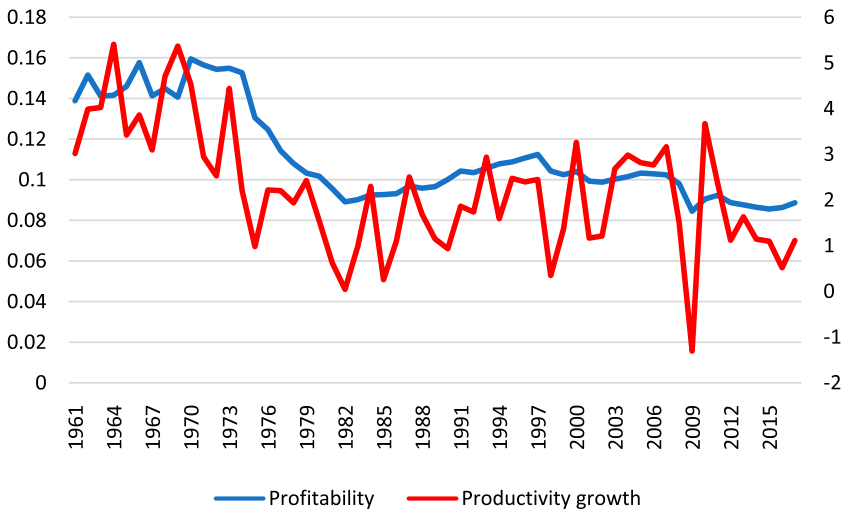
for green capitals; and proposals to use large-scale state planning and spending to galvanize a spike in private renewable investment (Newell, 2021; Gabor, 2021).

What is often missed, however, is that such a renewable spending boom will have to swim against the current of the long-term global slowdown in investment. For this reason, it is important to bring the scholarship on decarbonization into conversation with literature on contemporary stagnation.

### Global stagnation

Following 2008, the world economy failed to return to its pre-crisis growth trajectory. World GDP growth registered at just 2.3% in 2019, compared to 4.3% in 2007 (Figure 1). Against this background of weak recovery, former US Treasury Secretary Lawrence Summers suggested in 2013 that several economies, including the US, Japan, and Europe, may be trapped in a state of what Keynesian economist Alvin Hansen had termed 'secular stagnation' in the 1930s (Summers, 2013). Summers' diagnosis provoked a wave of scholarly discussion on the suboptimal performance of the post-2008 global economy. However, numerous academics have observed that capitalism has lacked dynamism for several decades. Krugman (2013) dates the onset of stagnation to the 1980s, Storm (2019) traces it to the mid 1970s, and Brenner has labelled the years 1965–1973 a transition period from 'long boom to long downturn' (2006: 37). As Figure 1 demonstrates, GDP growth and investment have trended downward globally since at least the 1970s, when the tremendous economic boom that followed World War II began to wane. Among the G20, business profitability and productivity growth have also remained low relative to the post-war 'Golden Age' (Figure 2).<sup>2</sup>

This paltry global economic performance is particularly jarring considering that it has coincided with extraordinarily favourable business conditions since the 1980s. These include an expansion of free trade that scooped billions of new workers and consumers into the capitalist fold, '[w]aves of deregulation and privatization' that pried various sectors open to market competition, low corporate tax rates, and the falling price of capital goods (Dobbs et al., 2015: 1–5). Of equal importance has



**Figure 2.** G20 profitability and productivity growth. Data covers 19 economies, minus EU. Profitability data is author's construction from the Penn World Tables' Real Internal Rate of Return series, available from [ggdc.net/pwt](http://ggdc.net/pwt). Data for Saudi Arabia begins in 1970 and Russia in 1990. Productivity growth data is author's construction from the Conference Board's Output per Employed Person Growth series, which is adjusted for falling ICT prices, with data for China taken from alternative rather than official estimates, available from [conference-board.org/data/economydatabase](http://conference-board.org/data/economydatabase).

been a tremendous monetary stimulus, powered by financial liberalization, falling interest rates, and infusions of liquidity into the economy by central banks (Copley, 2022). Finally, this period saw China's entry into the world market, with Chinese GDP growing by an average of 9.7% from 1980–89, 10% from 1990–99, and 10.4% from 2000–2010 (World Bank, 2021). China's expansion boosted the fortunes of global capitalism in several ways, from providing multinational corporations with a massive supply of cheap, disempowered labourers to fuelling the 2000–14 commodity boom that lifted the prospects of primary-commodity-producing countries to rescuing the global economy from its post-2008 doldrums through gigantic stimulus measures (Giraud, 2020; Naughton, 2018). Nevertheless, these unprecedented stimuli only managed to pause the downward trajectory of the world economy.

Although concern about stagnation has tended to focus on advanced capitalist economies, evidence increasingly suggests that stagnation is spreading to so-called emerging markets. China is now undergoing what the IMF (2019: 13) calls a 'structural slowdown'. This has spelled disaster for primary commodity exporters, with the entire region of Latin America and the Caribbean registering growth of just 0.8% in 2019 (World Bank, 2020: 95, 141). In fact, across emerging markets and developing economies as a whole, GDP growth has trended downwards since 2010, while debt levels have risen (Kose et al., 2020: 42). These troubling indicators reflect in part what the World Bank (2020: 193) has identified as a 'broad-based slowdown in labour productivity growth ... since the global financial crisis' in emerging and developing economies, itself driven chiefly by weak investment and efficiency gains. It was against this fragile background that the COVID-19 pandemic, with its unprecedented economic disruptions, struck in 2020.

## Causes of stagnation

While there is growing acknowledgment of the reality of protracted economic stagnation, there is little agreement on its causes. For the purposes of this article, it is useful to group the existing explanations into three main types: Mainstream, Power Relations, and Capitalist Contradictions.

Mainstream accounts rely on exogenous and contingent factors to explain stagnation. Exogenous explanations point to causes originating outside of the market system that have imposed limits on *potential* economic growth. Slow population growth is a commonly cited factor (Krugman, 2014), which formed an important element of Hansen's original theory of secular stagnation (Eichengreen, 2015). Another factor is weak productivity. Gordon (2017) claims that the 'digital revolution', based around computer technologies, did not have the same economic impact as earlier innovations like the internal combustion engine, and what growth-boosting effects it did display had begun to exhaust themselves by the mid 2000s (ibid).

Contingent explanations claim that the *actual* trajectory of GDP growth has been *below potential*. For such explanations, contemporary stagnation is chiefly characterized by 'an excess of desired saving over desired investment', which impedes growth and presses down interest rates (Eichengreen, 2015: 1). The explanation for this savings/investment imbalance is found in an array of contingent causes. Summers (2015) embodies this approach well. Low investment is partly explained by the falling price of capital goods, meaning that less investment is required to produce the same output. High savings result from various factors, including heightened income inequality, the preference among emerging economies to hold large foreign currency reserves, and high costs of financial intermediation post-2008 (ibid).

Such Mainstream accounts are unsatisfactory for several reasons. Firstly, exogenous explanations are hardly exogenous at all. Demographic changes are impacted by capitalist dynamics, as Marx (1976) elaborated in his critique of Malthus. Weak productivity too could just as easily be a result of stagnation as a cause of it (Benanav, 2020). Secondly, contingent explanations highlight important empirical trends but fail to integrate them into a coherent theory of *capitalist* stagnation. Schwartz' critique of Gordon (2017) applies to mainstream stagnation explanations more broadly: Gordon's book 'has no theory of capitalist dynamics – there is no index entry for "profit"' (Schwartz, 2021: 7).

Power Relations accounts seek to rectify the Mainstream's lack of attention to 'changes in institutions and power relationships between social classes' (Hein, 2015: 2). These explanations argue that capitalist dynamism has been drained by the ascent of certain powerful groups or institutional forms. The most popular explanation focuses on rising inequality. As Storm (2019: 18) writes, since the 1980s, there has been a 'reorientation in macroeconomic policy, away from full employment and towards low and stable inflation'. This political shift ushered in 'labor market deregulation, a scaling down of social protection, a lowering of the reservation wage of workers, and a general weakening of the wage bargaining power of unions' (ibid). This attack on labour translated into economic stagnation through several mechanisms. Firstly, disempowered workers means structurally low demand, which disincentivizes investment (Cynamon and Fazzari, 2015). Secondly, low wages negate the need for businesses to invest in labour-saving technologies, hindering productivity growth (Storm, 2019). Weak investment and productivity in turn hurt wage and demand growth, entrenching a cycle of stagnation.

A second Power Relations explanation insists that the post-1980s economy has become financialized. Key to this approach is the rise of shareholder value ideology, which dictates that the primary goal of corporate managers should be to enrich their shareholders (Crotty, 2003). As a result, industrial firms reoriented their strategies away from long-term productive investments and



towards short-term measures to boost their share price, including share buy-backs (Stockhammer, 2004). Further, a rising proportion of retained earnings has been paid out to shareholders in the form of dividends, draining the pool of capital that could be used for productive investment. Lastly, a growing fraction of corporate income has been captured by financiers in the form of interest payments (Dumenil and Levy, 2002). The results of this financial power-grab are ballooning financial markets and weak investment that limits economic growth.

A final explanation of stagnation within this vein focuses on rentierization (Mazzucato, 2018; Schwartz, 2021). Christophers (2020) has advanced the most rigorous analysis of ‘rentier capitalism’. The neoliberal period, he argues, has seen a growing share of corporate income accrue to capitals that have established monopoly positions, free from competition. Such rentierism encompasses not just banking monopolies, but the ownership or control of natural resources, digital platforms, infrastructure, land, outsourcing contracts, and intellectual property. Economic stagnation naturally follows: ‘Rentierism stifles innovation, depressing the dynamism of capitalist economies’ (ibid: xxvii).

Power Relations accounts improve upon the Mainstream’s depoliticized analyses. However, many of these explanations trace the ultimate cause of stagnation to a 1980s political transformation, which is itself treated uncritically as a sort of original sin. For accounts that focus on inequality, the ultimate cause was ‘the deliberate creation after 1980, through economic policies, of a structurally low-wage-growth economy’ (Storm, 2017: 170). Financialization has its roots in a policy agenda of ‘radical deregulation pushed by financial institutions and justified by efficient financial market theory’ (Crotty, 2009: 564). Rentierization too is ‘the result of neoliberalism’ – that is, purposeful political decisions (Christophers, 2020: 21). But what caused these policy changes? The answer tends to be sought in a combination of neoliberal ideology and elite/financier/rentier lobbying in a context of economic turbulence. The fact that this neoliberal policy revolution was in large part a *response* to the grinding stagnation of the 1970s is inadequately theorized (Copley, 2022). It is this stagnation, which preceded the spike in inequality and the ascent of the financier and rentier, that must be explained.

Capitalist Contradictions accounts rise to this task, locating the cause of stagnation in the self-defeating character of capitalist development itself (Clarke, 1988; McNally, 2011; Brenner, 2006). A central factor underpinning the postwar boom – the spread of US industrial technologies first to Europe and Japan and then the Newly-Industrialized Countries – was also its undoing. As national economies responded to competitive pressures by chasing US labour productivity standards, the result was a massive rise in industrial capacity that flooded markets with manufactures, exceeding demand and driving down prices and profitability. Falling profitability disincentivized further investment, in turn dampening productivity, wage, and demand growth. The 1980s and 1990s witnessed a partial recovery in global profitability (Figure 2), driven by the favourable business conditions discussed in the previous section. Yet this moderate upswing had petered out by the early 2000s, as the world market again became glutted, capped by the 2008 financial collapse. The global economy has since hobbled on, propped up by extraordinary central bank activism, only to be violently jolted again by the COVID-19 pandemic.

These accounts highlight that the neoliberal political agenda, which Power Relations accounts identify as the mainspring of contemporary stagnation, was in fact a result of it. Strategies to reduce worker bargaining power, seek profits through financial channels, or establish monopoly positions constituted rational responses to a lack of profitable investment opportunities. The resultant spike in inequality and rentier power may have further exacerbated stagnation. But the prime mover was the self-generated exhaustion of capitalist dynamism.



While broadly Marxist, Capitalist Contradictions approaches are theoretically heterogeneous. Brenner (2006), for instance, eschews classic Marxist crisis theories, instead rooting his account in the anarchy of capitalist competition, while others debate whether falling profitability signals a cyclical or terminal crisis of capitalism (Larsen et al., 2014). However, the most convincing accounts anchor stagnation in a non-deterministic interpretation of Marx's value theory that emphasises the secularly increasing difficulty (but not impossibility) of maintaining economic dynamism in the face of capitalism's unending productivity race (Moraitis, 2021; Ortlieb, 2014; Clarke, 1994).

Through repeated market exchange, capitalist producers accidentally establish averages of labour time required to create different commodities (Marx, 1976). These labour productivity standards constitute the 'values' of commodities, around which their prices fluctuate. To survive on competitive markets, capitalists must match or exceed the average labour productivity for their sector through continuous technological innovation, setting capitalism along a historical path of perpetually rising labour productivity. This dynamic is expressed as a growing output of commodities that each have lower values and fetch lower prices, meaning that capitalists must sell more commodities just to realize the same value as before (Marx, 1981). The necessity to continuously expand the scale of production just to tread water in value terms creates a powerful tendency towards overproduction, overcapacity, and declining prices that results in downward pressure on profitability. Falling profitability deters new investment and conjures the spectre of generalized economic stagnation. This tendency can be countered by a variety of developments, from expanding market demand to falling production costs. Yet such counter-tendencies must take place on an ever-larger scale as labour productivity continues its relentless climb. Paradoxically, 'the more productive capitalism has become, the more it struggles to emulate past patterns of economic prosperity' (Moraitis, 2021: 11–12).

If such accounts are correct – if the slowdown is an expression of capitalist development, rather than a corruption of it – then stagnation is an intractable problem that states must navigate in pursuing decarbonization.

### *Perverse dynamics*

The mainstream decarbonization vision calls for a massive investment boom, the likes of which have proven difficult to generate since the 1970s because of weak economic dynamism, itself a result of the contradictory nature of capitalist development. This gives rise to a series of dilemmas, or what Heun and Brockway (2019) term 'perverse dynamics', for states seeking to tackle climate change.

### *Slowing growth, slowing emissions*

As critics of growth observe, an economy geared towards endless expansion will test the limits of the natural world. Whether this tendency can be overridden with regards to climate change depends upon the nature of the relationship between growth and carbon emissions. Significant debate exists over whether GDP can be 'decoupled' from emissions. There are two forms of decoupling. *Relative* decoupling indicates that GDP increases at a faster rate than carbon emissions. *Absolute* decoupling, which matters most for climate change, signifies that GDP increases with zero rise in carbon emissions. While there has been a 'steady long-term trend towards relative decoupling' within the world economy, it is not clear that absolute decoupling can be achieved at a pace necessary to meet the Paris goals (Hickel and Kallis, 2020: 8). As a recent systematic review of the scientific evidence

stated, ‘a continuation of past trends will not yield absolute reductions of resource use or GHG [greenhouse gas] emissions’, indicating the stubbornly tight association between growth and carbon emissions (Haberl et al., 2020: 34).

Given that economic growth is now and has historically been the key driver of emissions, economic stagnation helps to lower emissions by reducing energy use. The only significant declines in global carbon emissions in the last 30 years have coincided with steep reductions in growth, that is, the USSR’s collapse, the 2008 crisis, and the COVID-19 pandemic (Le Quéré et al., 2020: 650). Furthermore, a study of 18 countries that managed to ‘peak and decline’ their carbon emissions in the period 2002–2015 demonstrated that one key driver of this process – accounting for 36% of the fall in emissions on average – was decreased energy use that resulted in part from ‘low growth in GDP of around 1%’ (Le Quéré et al., 2019: 215). As the GDP growth rate approaches zero, absolutely decoupling growth from carbon emissions becomes more feasible (Schroder and Storm, 2020). This is a core insight of the degrowth literature (Mastini et al., 2021: 3).

### *Frustrated decarbonization of stagnant industries*

Nevertheless, as Le Quéré et al. (: 217) point out, even the reductions in carbon emissions achieved by the slow-growing advanced economies ‘fall a long way short of the deep and rapid global decarbonization of the energy system implied by the Paris Agreement’. Contemporary stagnation is, on its own, completely inadequate to address climate change. In fact, this economic slowdown impedes decarbonization efforts in various ways.

First, stagnation obstructs energy efficiency gains. High growth is associated with strong gains in energy efficiency: ‘rising GDP means more money available to invest in new final-to-useful machines and equipment with higher energy efficiency’, and this energy efficiency in turn powers more GDP growth (Heun and Brockway, 2019: 11). Low growth is thus associated with poor gains in energy efficiency, as less funds are available for investment in new technological capacity, impeding future growth. Consequently, stagnation is a disaster for the conventional vision of decarbonization because, as discussed earlier, ‘energy efficiency is firmly embedded as a key mitigation strategy within Integrated Assessment Models’, ‘contributing up to 40% of the envisaged reductions in global greenhouse gas (GHG) emissions over the next two decades’ (Brockway et al., 2021: 1).

Second, stagnation obstructs the decarbonization of industrial processes. This problem is clearly visible in heavy industries, which best typify the self-undermining dynamics identified by Capitalist Contradictions explanations. Steel is a key driver of climate change, responsible for 7–9% of global carbon emissions (World Steel Association, 2019). In most steel production, molten iron is extracted from iron ore in a blast furnace at high temperatures generated by the burning of coke, which releases CO<sub>2</sub>. There are several options to decarbonize this process. The most viable long-term solution, according to McKinsey (Hoffman et al., 2020), in addition to the use of scrap steel, is to use ‘green’ hydrogen to create ‘direct reduced iron’ that can then be processed in an electric arc furnace.

The problem, the *Financial Times* reports, is that the cost of ‘overhauling a monolithic and slow-moving smokestack industry ... could run into hundreds of billions of dollars — not easy in a business plagued by chronic oversupply and volatile swings in profitability’ (Pooler, 2021). Indeed, from 2000 to 2014, global steel capacity more than doubled, as non-OECD economies expanded their production, flooding markets with steel and outpacing demand (OECD, 2015: 7). The result has been profound stagnation, argues the Global Forum on Steel Excess Capacity (2017: 2): ‘The situation has become particularly acute since 2015. It depresses prices, undermines profitability’, and ‘undermines the fight against environmental challenges’. This endangers efforts to retire or

retrofit carbon-intensive plants and build carbon-neutral ones: ‘It takes years to plan, get permits for, finance, and build a steel ... plant, and once built, they can last for 25–50 years with proper maintenance. The current oversupply of steel plants ... naturally serve[s] to slow the development of newer, more innovative facilities’ (Bataille, 2020: 13). In order for steel firms to discontinue existing plants and invest in decarbonized processes, the price of green hydrogen must fall below a certain threshold. Such market conditions, McKinsey estimates, may be reached between 2030 and 2040, though only in Europe, which accounts for 11% of global steel production (Hoffman et al., 2020).

The case of steel is illustrative of the profound challenges of decarbonizing stagnant industries, especially those with high capital intensity. The automobile industry displays similar characteristics. In response to global competition, this sector has developed massive economies of scale and requires expensive fixed investments. For such investments to be profitable, manufacturers must ensure a high and stable volume of sales. But the industry’s huge productive potential regularly outstrips demand, leading to endemic overcapacity and falling prices (Holweg and Oliver, 2016). The result has been secularly falling profitability over the long run: ‘typical profit margins were 20–30% in the 1920s, 10% in the 1960s, and lower than 5% in the 2000s’ (Mattioli et al., 2020: 5). Such precarious financial conditions militate against an expensive, green reconfiguration of the industry. This creates a tendency towards ‘carbon lock-in’, meaning the stubborn inertia of carbon-intensive systems, which governments are seeking to pry apart through support for electric vehicle production (ibid; IEA, 2020).

### *Contradictions of renewable power*

If economic stagnation acts as a drag on both energy efficiency gains and the decarbonization of industrial processes, then even greater investment in renewable power is required to meet the Paris targets. Yet this enlarged investment requirement is also obstructed by the same economic slowdown, characterized as it is by paltry rates of investment.

This is reflected in the weak investment trends in most renewable energies. The IEA (2020) monitors changes in renewable power generating capacity and compares them to its Sustainable Development Scenario, that is, a hypothetical trajectory of decarbonization that avoids catastrophic global heating. Of the nine renewable power sources observed by the IEA, from wind to ocean power, only two are ‘on track’, namely solar PV and bioenergy. Geothermal energy, for example, attracted just \$20 billion in global investment from 2010–2019 – the same amount of money the US spends annually on direct subsidies to the fossil fuel industry (Frankfurt School-UNEP Centre/BNEF, 2020: 31; EESI, 2019). Investment in carbon capture, utilization, and storage in the power sector is also far off target, despite increased spending on this technology in 2021 (IEA, 2020; McCormick et al., 2021). These weak investment trends mean that renewable energy growth has not managed to outpace the rise in overall energy use: ‘Since 1990, the share of renewable energy in total final energy consumption (TFEC) has remained relatively steady’ (IEA et al., 2021).

However, not every renewable sector has suffered from paltry investment. Solar PV power generation has been the standout renewable energy of the last decade. In 2000, Germany introduced a feed-in tariff scheme to stimulate domestic solar PV production, and other nations followed suit, catalyzing the expansion of this industry and leading to the establishment of a standardized design for crystalline silicon cells (Hipp and Binz, 2020). From the mid-2000s, China rapidly increased its share of global solar PV manufacturing – bolstered by state support – dominating the industry by 2015. The outcome of China’s entry was a massive boost in investment and competition. Investment totalled almost \$1.4 trillion in the period 2010–2019, resulting in productivity-boosting process innovations that drove down the price of solar panels, leading solar-PV-generated electricity prices

to fall by as much as 82%, undercutting even the cheapest coal-fired power plants (Frankfurt School-UNEP Centre/BNEF, 2020: 31; IRENA, 2020b: 11).

These production and price dynamics have been heralded by intergovernmental organizations as evidence of the feasibility of market-driven decarbonization efforts, with IRENA (2021: 17) and the IEA (2021: 19) expecting solar PV and wind to together constitute 60–70% of all electricity generation by 2050. Yet it is precisely this success that is threatening the future growth potential of solar PV. This same collapse in prices has eroded the profitability of the industry (Garlet et al., 2020). As firms compete globally to produce more standardized solar panels at a lower cost, only the most efficient producers can survive. Consequently, a wave of bankruptcies struck the industry in the early 2010s, with the number of panel manufacturers closing or declaring bankruptcy rising more than sevenfold from 2011 to 2012 (Wesoff, 2015). Surviving firms have sought to insulate themselves from competition through vertical integration and the deployment of patents and trademark protection on solar PV products and services (WIPO, 2017). The sector is currently wracked by overcapacity. In China – the industry’s geographical hub – one study found that 91% of listed PV companies had overcapacity problems, with an average degree of overcapacity of around 55% (Yu et al., 2021: 10). The ‘sheer weight of investment may have been part of the problem’, another report admits, as it has translated into ‘persistent overcapacity, meaning it is still hard for manufacturers to turn a profit’ (Frankfurt School-UNEP Centre/BNEF, 2020: 71).

Within the solar PV value chain, the midstream section (manufacturing) appears to have faced the greatest profit squeeze (Garlet et al., 2020). However, similar profitability pressures are being exerted upon downstream operators of solar farms. The problem is a familiar one. The competitive struggle to raise capacity exerts a downward force on prices and profit rates, threatening the continued growth of the sector: ‘revenues per kW of installed capacity will decline as solar penetration increases until a breakeven point is reached, beyond which further investment in solar PV would be unprofitable’ (MIT Energy Initiative, 2015: xix). This ‘self-limiting aspect of solar generation’ expresses a fundamental contradiction inherent to capitalism’s growth engine (ibid). Yet factors peculiar to utility-scale solar PV exacerbate this general dilemma. A solar farm can only generate power when the sun is shining, which happens to be ‘when all the other solar plants are cranking out electricity at maximum levels as well’, resulting in a kind of super overproduction that drives down prices, sometimes into ‘negative territory’ (Temple, 2021).

The renewable power sector is caught in a bind. For most renewables, investment has been paltry. Yet even the much-celebrated solar PV sector has proven vulnerable to the self-undermining dynamics that grip much of global industry. As Capitalist Contradictions accounts insist, the competitive impulse to boost labour productivity, which gives capitalism its unique potency, also generates conditions of overproduction and dwindling profitability. The outcome is that new global investment in renewable power has remained flat since 2015 (Frankfurt School-UNEP Centre/BNEF, 2020: 61).

### *Sapping political ambition*

Intractable economic stagnation also puts pressure on political authorities to simply abandon ambitious decarbonization targets. Governments’ legitimacy is closely tied to their ability to facilitate dynamic capital accumulation within their borders – generating jobs, incomes, and tax revenues. The long economic downturn thus poses a serious threat to governing legitimacy. If governments do not perceive decarbonization initiatives as positively contributing to growth, then political pressures arise to deprioritize them.

This was clearly demonstrated following the 2008 financial crisis – a painful shock to an already poor-performing world economy. The need to restart economic growth was an important factor that hamstrung the 2009 Copenhagen climate negotiations (Christoff, 2010). The crisis and its after-shocks had a particularly destabilizing impact on European climate ambitions, as stringent financial conditions limited member states’ appetite and ability to undertake costly decarbonization measures, as well as weakening the EU as a global climate actor (Burns and Tobin, 2018). China’s post-2008 stimulus, containing large green investment provisions, offered a glimmer of hope. Yet this was overshadowed by China’s propulsion of ‘vast energy-intensive construction projects’, ‘support for industries heavily dependent on fossil fuels’, and suspension of growth-unfriendly environmental regulations – demonstrating ‘the far greater priority the leadership attached to sustaining economic growth in the face of a global recession’ (Sandalow, 2019: 32).

It remains to be seen whether the COVID-19 crisis will see governments overcome their tendency to respond to economic shocks by seeking to rescue growth at the expense of the climate. The initial evidence suggests not. UNEP reports that of the ‘enormous fiscal spending from governments around the world in 2020’, only 2.5% ‘was announced for green initiatives’ (O’Callaghan and Murdock, 2021: 2). China – the world’s leading carbon emitter – exemplifies this. After ambitiously pledging to achieve carbon neutrality by 2060 in November 2020, China ended up emitting more carbon in 2020 than 2019, despite the COVID-19 lockdown. The reason for this retrogression, according to *Carbon Brief*, is that ‘[p]olicymakers doubled down on the old playbook of stimulating the dirtiest and most energy-intensive sectors’, namely construction and heavy manufacturing, in order to deliver growth (Myllyvirta, 2021).

Finally, it is notable that many of the countries that have successfully peaked and declined their carbon emissions – such as the US, UK, France, and Italy – have only achieved this by registering growth so low that it has destabilized their domestic politics, contributing to the macro conditions for the proliferation of populist and extreme right political tendencies (Jager and Borriello, 2020). In turn, many ascendent far right parties are climate sceptical, further entrenching the political inertia surrounding climate action (Lockwood, 2018). In other words, the economic circumstances that have allowed for significant decarbonization in several countries have been experienced by their political establishments as an institutional crisis that must be reversed.

## Conclusion

Preventing catastrophic climate change will require the decarbonization of the global economy. Political economists have wrangled over whether this energy transformation would be aided or hampered by a context of continuing economic growth, with green growth and degrowth accounts representing the two poles of this debate. Insufficient attention has been paid, however, to the actual historical trajectory of weakening growth over recent decades. Explanations abound for this slowdown, but the most compelling accounts trace its roots to contradictions inherent to capitalist development, whereby the competitive struggle to raise labour productivity inadvertently generates overproduction, falling prices, and declining profitability. Addressing climate change within a market framework will mean contending with these stagnant economic conditions. For states tasked with pursuing decarbonization, this entails a series of perverse dynamics: the slowdown in GDP growth reduces energy use, while at the same time impeding energy efficiency gains; overcapacities in carbon-intensive heavy industries hinder the decarbonization of industrial processes; ostensible success stories like solar PV are increasingly plagued by waning profitability; and the political legitimacy concerns generated by economic stagnation press governments to scale back ambitious decarbonization plans.

These contradictions of decarbonizing the downturn create a powerful tendency towards inertia in the face of unprecedented catastrophe. Confronted with this paralysis, states are increasingly likely to violate liberal governance norms, intervening to accelerate decarbonization and manage the fall-out of environmental disasters (Alami et al., in progress). The outlines of this political playbook can be detected in central banks' permanent-emergency measures post-2008 and in states' forceful responses to the early COVID-19 pandemic (Tooze, 2021). These interventions do not point towards a lasting solution to the climate crisis – they represent ad hoc efforts to repair the tears in the socio-environmental fabric created by capital accumulation while reproducing capital accumulation all the same. Yet they may prove productive insofar as they break the spell of the liberal worldview, creating space to imagine how decarbonization could be achieved in a planned and democratic manner (Alami et al., in progress).

Degrowth accounts have taken seriously the limitations of market-based decarbonization and offered innovative alternatives (Liegey and Nelson, 2020; D'Alisa et al., 2015). However, the degrowth vision contains important ambiguities. For instance, it is regularly described as post-capitalist, and yet many degrowth proposals fail to advance far beyond post-war social democracy, in terms of proposing the expansion of public services, full employment, and state regulation of private industry and control over money creation (Hickel, 2020: 205–250). Where similar political constellations existed in post-war Europe, they relied upon rapid growth. How would such a system be recreated in conditions of stagnation? Introducing a raft of regulations, restrictions, and taxes would further disincentivize already weak green investment, so long as key investment decisions remained in the hands of private firms that must maximize profitability or face bankruptcy (Benanav, 2020). If this obstacle is to be overcome through a struggle to dismantle private industry and market competition, then what concrete mechanisms of social coordination could replace the market's 'invisible hand'?

Such discussions would be enriched by further engagement with scholarship on democratic economic planning. Democratic planning means forging deliberative procedures that allow stakeholders to participate in deciding how to utilize collectively held resources (Akbulut and Adaman, 2020; Lowy, 2007). The formulation of social goals, and plans to achieve them, would take place via an iterative process of negotiation between affected individuals that seeks to synthesize their diverse interests, cultures, and tacit and scientific knowledge (Devine, 2017). All areas of economic life need not be subordinated to an overarching master plan. Instead, economic democracy could operate at various scales, depending on social or environmental factors, and assume direct and representative forms. Agriculture, on the one hand, could be localized where possible for reasons of sustainability and self-sufficiency, requiring direct cooperation between a relatively small number of people (Clegg and Lucas, 2020). Solar panel production, on the other hand, requires complex coordination between many people across long distances – from energy users to manufacturing workers to communities affected by quartz mining. In this latter case, multi-scalar cooperation could be mediated by representative institutions and aided by various planning technologies (see Pendergrass and Vettese, 2022), including 'in kind' accounting (Benanav, 2021) or algorithmic management (Phillips and Rozworski, 2019). Yet economic governance would remain a matter of negotiation: stakeholders might decide to rapidly expand solar panel production so as to facilitate high energy usage, or production may grow more modestly, with energy use downscaled proportionately, in order to protect extractive zones. Nevertheless, the urgency of the climate emergency would further require an institutional framework to express all major economic activities in terms of their environmental (particularly carbon) footprints, and in turn enforce their reconfiguration along sustainable lines (Planning for Entropy, 2022). This would likely entail a degree of centralization and coercion that could come into tension with democratic principles.



Indeed, democratic economic planning is not a panacea – it would not guarantee the achievement of timely or equitable decarbonization. This would remain a matter of political struggle. However, such planning practices, by toppling the profit imperative, would disarm capitalism’s blindly expansionary and environmentally destructive logic. Additionally, planning would overcome the central stumbling block of capitalist decarbonization strategies, namely that renewable investment can only take place to the extent that it is profitable, in an economic context of depressed profitability. Rather than politics taking the form of ritualistic attempts to conjure private investors’ ‘animal spirits’, economic life would itself be politicized and consciously managed, allowing for the *direct* pursuit of decarbonization in a just fashion.

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### Notes

1. The IEA indicates that annual investment must reach \$5 trillion by 2030.
2. An anonymous reviewer raised the important point that the post-1970s era only appears economically stagnant when compared with the unprecedented growth of the 1950s–1970s – the latter also being a period of accelerating environmental harm. The post-1970s era may simply signal a reversion to the norm of relatively modest growth. Offering a definitive judgement of this argument is challenging for several reasons. First, historical comparison is made difficult by limited global GDP data pre-1950 (Maddison, 2006). Second, even where pre-1950 data is available, it is difficult to find an appropriate period for comparison with contemporary growth. The obvious candidate is the ‘first globalization’ wave (1870–1914), which saw growth rates similar to today’s, at least in Europe (Carreras and Josephson, 2010: 36). Yet within this period, 1873–1896 was characterized by the ‘long depression’, complicating these growth figures. Third, pre-1914 economic growth was restricted by several factors that do not apply today, including the Gold Standard’s deflationary mechanism, a circumscribed mass consumer market, and limited developmental opportunities for colonized nations. Nevertheless, in this article I advance two arguments that do not depend on providing a definitive answer to this puzzle. Firstly, as labour productivity rises, it becomes increasingly difficult to sustain incumbent levels of capitalist dynamism. This does not imply that today’s world economy has sunk to historically unique lows – it simply indicates that ever greater stimulus measures are required just for capitalism to tread water in growth terms. Secondly, contemporary stagnation represents a profound obstacle to decarbonization visions that depend upon booming green investment. Whether this stagnation is unprecedented or not does not affect the validity of this claim.

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