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Research article

Planetary good governance after the Paris Agreement: The case for a global greenhouse gas tax

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ABSTRACT

The Paris Agreement and the subsequent IPCC *Global Warming of 1.5* °*C* report signal a need for greater urgency in achieving carbon emissions reductions. In this paper we make a two stage argument for greater use of carbon taxes and for a global approach to this. First, we argue that current modelling tends to lead to a "facts in waiting" approach to technology, which takes insufficient account of uncertainty. Rather than look to the future, carbon taxes that facilitate social redesign are something we have control over now. Second, we argue that the "trade" in "cap and trade" has been ineffective and carbon trading has served mainly as a distraction. Carbon taxes provide a simpler more flexible and pervasive alternative. We conclude with brief discussion of global context.

1. Introduction

Atmospheric greenhouse gases (GHGs) or more generically "carbon emissions" do not respect borders and so "decarbonisation" is everyone's problem. It is either achieved everywhere or undermined globally. It is, in a literal sense, a planetary problem. Not all places and people are equal sources of, or are equally responsible for, carbon emissions, and not all people and places are or will be able to equally buy their way out of some of the immediate consequences, but in the end climate change is a pervasive existential *civilizational* challenge. This creates scope for global responses, including a global greenhouse gas tax (GGGT).

Acknowledgement that emissions are a global problem and decarbonisation a global challenge, is not new. The United Nations Framework Convention on Climate Change (UNFCCC) was created in 1992, and beginning with the initial "Annex 1 parties" almost every country in the world eventually signed up to the Kyoto protocols and then the subsequent expansions and extensions in Copenhagen 2009, Cancun 2010 and Doha 2012. The Paris Agreement of 2015 has ensured that policy to reduce carbon emissions will continue in this decade and beyond. As is well-known, Article 2 (1a) of the Paris Agreement aims to restrict average global temperature to 1.5 °C above the pre-industrial level and the Agreement places this in the context of a broader aim to restrict warming to 2 °C. Every signatory is encouraged to be ambitious in setting its "nationally determined contributions" (NDCs) to emissions reduction to achieve this goal, based on a typical 5 year planning approach. However, as the United Nations Environment Programme (UNEP) ten year emissions gap summary report notes, there has been little to no progress on emissions reduction in the last ten years and the globally combined NDC commitments and implementations fall far short of the required reductions over the next ten years. According to the ten year summary, emissions at the end of the last decade were roughly equivalent to what they would have been under a "business as usual" (i.e. "no-policy") scenario since 2005 (Christensen and Olhoff, 2019: 3). The 2018 ninth emissions gap report stated emissions reached a record high of 53.5 Gigatonnes of $C0_2$ and equivalents ($GtC0_{2e}$) in 2017. Based on projected NDCs, the report states that emissions would still be 53 $GtC0_{2e}$ in 2030 and could rise to 59 $GtC0_{2e}$ in that year based on the "implementation deficit". Against this background, the Intergovernmental Panel on Climate Change (IPCC) called on the conference of the parties (COP) of the UNFCCC to accelerate and focus emissions reduction plans (IPCC, 2018) and this has become the now well-publicised need to reduce emissions by around 45% from the 2017 level by 2030 (around 7.6% reduction per year over the decade) and to "net-zero" by mid-century.

Though the eleventh emissions gap report in 2020 was not encouraging – emissions reached a new record high in 2019 – there are now signs that governments around the world have acknowledged that something must *really* be done (finally). It is now relatively

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uncontroversial that we have entered a period of "climate emergency" (Ripple et al., 2020) and the election of Joe Biden and the re-entry of the USA to the Paris process as well as China's signal that it intends to increase its commitments to emissions reduction ("carbon neutral" by 2060) seem to signal a direction of travel (however, see Climate Action Update Tracker, 2021; Smith, 2020). The UN, meanwhile, has launched the Climate Ambition Alliance to encourage countries to increase NDC ambition and launched the Race to Zero campaign to feed this through to cities, regions, business and other actors. The number of participants in the former and signatories to the latter are constantly increasing.

As such, radical and rapid decarbonisation of economies is now an explicit goal for some people and places and (from an existential perspective) an implicit goal for all. Clearly, it is important to ask, "What is the appropriate balance between policy mechanisms and what context informs the framing and implementation of policy?" And one might suggest that the ten year emissions gap summary report indicates that recent forms of policy and their implementation have been collectively ineffective, though more needs to be said about this. "Carbon pricing" has been a major pillar of policy and this has two variants: carbon trading and carbon taxes. In this paper we argue that a carbon tax should be preferred over carbon trading and that a global approach to such a tax is the most effective way to achieve this. We approach this in a two stage argument. First we argue a carbon tax should be prioritised, because of the problem of hidden technological assumptions built into the current mitigation and adaptation pathways, which treat an uncertain future as "facts in waiting". A carbon tax does not necessarily depend on technology, it is something we have more and immediate control over and is compatible with a greater emphasis on achievable prudential social redesign. Second we argue that carbon trading has proved relatively ineffective and as such carbon trading provides a simpler alternative. We conclude with brief discussion of why a carbon tax should be global and make the point that a GGGT can be implemented in the context of a "global Keynesian" framework. This final argument is intended to be preliminary and indicative rather than comprehensive.

2. Facts in waiting? Models, pathways and technologies

It has not yet been fully appreciated by the public just how radical a change to society and economy "net-zero" is likely to be. Our societies are dependent on carbon and produce GHGs in multiple ways, many of which are not obvious to the public. Transport and power generation are visible sources but many manufacturing, construction, and agricultural emissions sources (concrete, plastics, fertilizers, other chemicals, metals, medicines, meats etc.) are carbon dependent and carbon producing. Industrialised consumption focused economies have been built around carbon. Carbon is pervasive. As such, a "decarbonised" economy implies a society with a quite different basis. When the IPCC and UNEP call for action mobilised at equivalent scale to war planning it is this level of challenge that they have in mind. Yet, so far, the itemised list of ways (plant trees, adopt renewable energy, travel less, buy electric, eat less meat etc.) societies as a whole and people individually are being made aware of, which might reduce their carbon emissions, has not quite translated into a realisation that the *combined* implication is fundamental difference at a systemic level and thus radical change. Behind this lack of appreciation, moreover, stands a basic policy ambiguity, which we would argue skews our sense of how a "net-zero" future is to be achieved. Understanding this ambiguity foregrounds the case for social redesign and carbon taxes.

Most governments, many think tanks and NGOs have over the years taken an interest in mapping out low or reduced carbon futures and the IPCC has been collating and publishing pathway scenarios for decades. "Net-Zero" has hardened goals and tightened time-lines, but not altered the fundamentals of scenario-*building* – at least of the kind that dominates. Scenarios map out possible futures and quantify relations with a view to setting out transitions in key metrics. Multiple problems have been identified with the models used – most notably Integrated Assessment Models (IAMs) such as DICE, which has created controversy regarding discount rates, damage functions and the social cost of carbon (see Asefi-Najafabady et al., 2020; Keen, 2020; Spash, 2002). However, the point we want to make is that all approaches, not just some models, make assumptions about the technology that will be available to achieve emissions reduction and ultimately "net-zero". If one looks to the IPCC pathway scenarios, for example, they envision technologies that are not carbon-dependent or carbon producing, technologies for carbon capture and storage and wide-scale changes to land-use and land management – hence "*net*-zero" rather than zero emissions at source. Clearly, technology is and will be an important feature of how we respond to "climate emergency". There are, however, two problems with the treatment of technology in relation to achieving emissions reduction goals.

First, social scientists, especially economists, tend to construct production possibility frontiers and then, in conjunction with data on productivity and economic growth, extrapolate some given *rate* of technological change. Simple IAMs, for example, tend to assume some given rate of technological change but include no specifics on the nature of technologies that have or will induce changes in their target variables. One cannot, however, *rely* on this extrapolation if the very basis of a future society and economy must be fundamentally different. A decarbonised economy is one that powers, produces, transports and services itself differently. It is, therefore, not reasonable to extrapolate rates if the purpose is to assume pathways can be achieved because of what has occurred in the past. The past was built around carbon saturated technologies, but we are anticipating futures which will not be built around them. This is not to suggest the point is entirely original. Most commentators acknowledge that achieving "net-zero" requires a new "industrial revolution" and that there have been several previous ones since the Eighteenth Century. Each has structurally transformed the basis of economy and society. Each, however, worked with, depended on and exacerbated issues of carbon emissions: chemicals, electrification, transistors, computers and servers and so forth. The required technological change is, therefore, different in its planetary or Earth system context in relation to carbon, not just in its socio-economic technological context. This, in turn, indicates a second problematic feature of how technology is treated for the purposes of achieving emissions reduction goals.

Simple IAMs do not tend to specify any particular technology, but they do set out a future predicated on technological change. The UNFCCC, however, does include a "technology mechanism" established in 2010 (Technology Mechanism, 2021). The Paris Agreement (UN, 2015) makes reference to this in Article 10, and states the aim of encouraging development of mitigation and adaptation technologies and the transfer of these to all Parties. There is then, a specific reference to the role of technology in the Paris Agreement, which brings to the fore its role in emissions reduction and capture. An anticipated role, however, is not the same as clarity in terms of what is being expected from technology and how realistic that is. Since the Paris Agreement is a general legal text it contains little detail on technology beyond emphasizing its important role. Article 10 simply provides a source of inferences that inform Articles 13 and 14. These Articles set out transparency and stocktaking frameworks in relation to assessment of each Party's NDCs and each links back, in terms of technology transfer, to Article 9, which establishes a "financial mechanism". However, when one reads through documents from the Technology Executive Committee and Climate Technology Centre and Network, which are the main bodies empowered to develop the "technology mechanism", and also main documents from the UNEP and IPCC on achieving "net-zero", such as the *Global Warming of 1.5 °C* report and the emissions gap reports, it becomes clear that two different meaning frames for technology tend to be folded into each other: technology *in* the future and technology *of* the future. What we mean by this distinction will become clear as we proceed with our second point regarding what is being expected from technology and how realistic this is – the issue can be decomposed according to assumptions used.

In setting out scenario pathways to achieve net-zero three basic assumptions apply to the role of technology. First, the relevant technology will be scalable i.e. the technology can be seamlessly transferred to "the field" once proof of principle and adequacy of operation are established in the laboratory or research and development unit. Scalability involves multiple issues, such as transfer from a closed controlled environment to an open system where offsetting factors and unintended consequences may apply, as well as more mundane issues affecting mass manufacturing. This latter point, in turn, speaks to a further issue of whether widespread application is likely to be facilitated by the kinds of economic systems we live in i.e. ones centred on market mechanisms. So, a second assumption, is typically that the technology can be commercialised, and while there are clear modifications that can be made to any given pricing system through subsidy and incentives that affect the balance of returns or profit made from a technology, the observable experience of many "environmental" technologies has been delay in the diffusion of the technology. This is because of problems of relative returns and profit incentives and because market-based approaches tend to shift responsibility from government and induce a market-psychology for the uptake of that technology. A market-psychology means that rather than view the uptake of a technology as a necessary feature of an adapted society, which everyone needs to adopt, it becomes a personal choice, typically conceived on the basis of monetised "investment" payoffs. These first two assumptions then, speak to a third issue, the assumed "feasibility" of any given technology.

Clearly, feasibility has different inflections: a technology can be feasible (or not) at scale and can be more or less feasible from the point of view of the practices of the economic system into which it is introduced, but there is also the issue of whether it can be feasible as culturally-socially-politically "acceptable" *and,* prior to the issue of scalability, there is simply the more basic problem of whether something can be considered possible at all. "Possible at all" invokes many issues – from can a technology be designed and manufactured that does X, to is achieving X compatible with planetary processes or Earth systems? All of which is to say that while assumptions that apply to technology can be decomposed, the real world context in which technology is developed and to which technology is directed remains complex and contingent.

Our point here is again not to claim great original insight, but rather to remind readers of the significance of these familiar points for the purposes of how climate policy is framed. We began by suggesting there was a policy ambiguity and this involved the problem of what we can expect from technology. It should now be clear that this ambiguity revolves around how technology is treated: in some cases as merely an extrapolated rate of change, in some cases involving different assumptions regarding scalability, commercialisation and feasibility. This returns us to the distinction we made between technology *in* the future and technology *of* the future, which we can now clarify, though not as a simple dichotomy. We mean that from the *present* point of view, the role of technology has two aspects that fold into each other in various ways: scenarios combine extrapolations of technologies that currently exist, technologies that might reasonably exist, technologies we can conceive of existing and technologies we hope could exist. All of which is to suggest that there is a basic and fundamental *uncertainty* regarding what we can expect technology to achieve in terms of Paris goals. One need only think of, for example, the different considerations that might apply to the substitution of electric vehicles for internal-combustion-engine vehicles, carbon capture technologies (both at source and atmospheric) and, at the extreme, geo-engineering projects that look to interfere in natural processes to offset climate effects (cloud seeding, atmospheric misting and so forth).

Clearly, commentators and analysts are aware that what can be expected from technology is contingent and the context involves uncertainty. At the same time, there is a danger that current attempts to construct consensus around the commitment to achieve goals becomes a counterproductive confidence that goals will be achieved in the future, merely because technologies have been folded into pathway scenarios. Put another way, we start to treat highly conditional possible futures as "facts in waiting". Consider what that means, future technology which may never be more than fiction provides an illusion of control over the future. This, of course, invokes the problem of "technocentrism" – a much-discussed concept in sociology and political economy. While it is not the only consideration, technocentrism clearly serves to skew our sense of how a "net-zero" future is to be achieved. Though the IPCC and UNEP and state-level bodies such as the advisory Committee on Climate Change in the UK may be aware that scenario pathways are conditional and may be at pains to foreground the urgency of the situation we now find ourselves in, they are *not* policymakers. They, at best, proffer policy, they are not where power resides and they do not decide.

A "facts in waiting" approach is highly attractive to policymakers because it allows them to acknowledge the urgency of the situation, articulate a need for change, but simultaneously delay potentially unpopular fundamental change. And deliberate delay need not be how this appears to the decisionmaker. At least, not in some adverse sense of obstruction with malign intent. If policymakers are presented with options that includes one that suggests: "technology X will develop over the next X years and will, as modelled, reduce emissions by an estimated X% over the period of diffusion, if targets are met", experience suggests policymakers are liable to converge on this option. This is not only because a modelled and quantified option carries authority, but also because, at least in some cases, it sets out a future which seems less disruptive now, since the emphasis is on technology eventually taking care of the problem. Of course, disruption is a relative term, dependent on the socio-economic context and ramifications of the technology. The point, however, is that "facts in waiting" create grounds to defer changes which require sacrifice, reductions, prohibitions and major and probably immediate systemic and behavioral change. All of which are rooted in major decisions to act which place an onus on government. In this context of future technologies the very use of the term "net" can acquire characteristics conducive to complacency and at worst manipulation (Dyke et al., 2021).

In contrast, social redesign is something over which we have control now and which depends less on technologies that may never be feasible and may never be realised. The feasibility of social redesign focuses more on political will and socio-cultural problems of community acceptance and political economy problems of powerful economic lobbies and interests. This is quite different than, for example, whether we will at some point in the future substitute all internal-combustion-engine vehicles for electric vehicles for over one billion vehicles and with the numbers growing annually (Morgan, 2020) or hit upon a scalable and effective technology of carbon capture &c.

We contend, therefore, that from a prudential point of view (invoked by the precautionary principle) and given the nature of our "climate emergency" as previously set out, proper understanding of the "facts in waiting" problem foregrounds the case for greater emphasis in the present on social redesign and on policy that can facilitate rapid transition in economy and society. This brings us to carbon taxes and alternatives.

3. The "business-as-usual" dilemma, Paris Article 6

Technocentrism and associated issues bring into question just what it means to transition from "business-as-usual". Arguably, much of what we have just discussed has played a role in why the UNEP ten year emissions gap report states the last decade and more have been "lost", though there is more to this. Carbon emissions are just one among several conjoint problems of climate change and ecological breakdown and the report states that the rate of emissions reduction has been insufficient to deal with the basic problem of the continually expanding size of the global economy i.e. the scale and intensity of energy and resource use because of economic and population growth (Christensen and Olhoff, 2019: 3). These, in turn, continually increase the size of the "problem" to be solved, despite some gains measured as "relative decoupling" in the form of $GDP energy intensity. Over the last two decades the cumulative problem of emissions has worsened, atmospheric $C0_2$ has increased, "carbon budgets" have been rapidly depleted, and this has ingrained future increases in temperature and induced changes we are already beginning to experience – erratic and extreme weather and so on. One would expect that in this emergency context, the claims made by states and corporations that they *really* intend to address the situation now carry greater weight because the impacts are now manifesting, the stakes are now higher and the problems greater. In February 2021, for example, the need for urgent action was recognised by both the UN Science-Policy-Business Forum and the fifth UN Environmental Assembly, both of which recognised the year as a "critical turning point". At the February Assembly the UNEP's Executive Director, Inger Anderson, stated:

Unless we take action, future generations stand to inherit a hothouse planet with more carbon in the atmosphere than in 800,000 years. Unless we take action, future generations will live in sinking cities. From Basra to Lagos. From Mumbai to Houston. Unless we take action, future generations will be lucky if they can spot a black rhino. And unless we take action, future generations will have to live with our toxic waste – which every year is enough to fill 125,000 Olympic size swimming pools (UNEP, 2021).

Still, we have been here before. For example, in 2007 then UNEP Executive Director, Achim Steiner, introduced the *Global Environmental Outlook Report* (GEO4) with the following words:

The systematic destruction of the Earth's natural and nature-based resources has reached a point where the economic viability of economies is being challenged and where the bill we hand our children may prove impossible to pay … We appear to be living in an era in which the severity of environmental problems is increasing faster than our policy responses.

Given the urgent need to translate recognition into action it is important to ask, "What is the appropriate balance between policy mechanisms and what context informs the framing and implementation of policy?"

Article 6 of the Paris Agreement provides the foundational set of statements for policy mechanisms. A notable source of discord up to and including COP 25 in Madrid, however, has been how to create a rule book for policy mechanisms building on Article 6 (Carbon Brief, 2019). There are currently several draft rulebooks in development (e.g. UNFCCC, 2020). Three main areas have been under discussion – developing Article 6 (2) (4) and (8). These are: voluntary cooperation (one country can transfer (likely sell) any "overachievement" on its commitments to another as "internationally transferred mitigation outcomes" or ITMOs); a new carbon market (transferring from and/or replacing the system created under the Kyoto Protocols) and the adoption of non-market approaches.

For example, Article 6 (8) states: the "Parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties to assist in the implementation of their nationally determined contributions" and directs this to: "Enhance public and private sector participation". To be clear, however, the main subject matter here is non-market climate cooperation between countries (i.e., development aid), rather than forms of domestic economic intervention. It is Article 6 (4) which is most significant for the relation between different forms of economic policy, what they seek to achieve and how.

Dispute since Paris invokes a longstanding set of debates in environmental economics and with ecological economics. Thirty years and more of neoliberal policy development has created a general antipathy to prohibitions and "command and control" solutions. These have become last resorts. Moreover, there has been a longstanding tendency to dichotomise state and markets and this has influenced environmental policy and how solutions have been framed. For example, the dichotomy was basic to Robert Solow's analysis in his Ely Lecture, published in the *American Economic Review* (Solow, 1974). Yet as Herman Daly noted in the same issue and as many ecological economists have argued since, a market versus non-market focus tends to put aside the more fundamental issues of scale and intensity of economies – i.e., the primary problem or dilemma of what scale of economy is compatible with the Earth system in which it is embedded, and, as a corollary, the feasibility and nature of economic growth (Daly, 1974). This is a problem that transcends the relative emphasis on state and market. Ecological economists argue that the policy frameworks which have been developed over the last four decades have marginalised this issue (Spash, 2017).

Still, Article 6 of the Paris agreement seems promising – ostensibly invoking a "by any means necessary" approach. However, its simple statement leaves the Paris Agreement uncommitted and lacking in guidance in terms of the relative role and emphasis on "state and market", as well as the more complex ways one integrates with the other. Yet this is not a neutral stance, since it neither flags nor contests current economic conditions and frameworks. In this sense, it already has context. Article 6 reproduces a basic failure to address the expansion in scale of world economy, which the ten year emissions gap report alludes to. It may, therefore, tacitly facilitate the continuation of unsustainable types and levels of activity, despite its formal commitment to solve the problems which inhere in those activities. Development of Article 6 is also a site for conflict over subsequent rules, which reflect different interest groups, but also fundamentally reflects conformity to power, which in the present circumstances tends to encourage market conforming varieties of emissions reduction. The development of Article 6, therefore, risks continuity with "business-as usual". As the recent World Bank report *State and Trends in Carbon Pricing* (Santikarn et al., 2020: 29–45 and 85–95) indicates, though it is not yet clear how Article 6 will evolve, carbon trading and carbon taxes are set to continue to play a significant role in emissions reduction policy. And:

97 Parties now mention carbon pricing in their NDCs, indicating that they are planning or considering the use of climate markets and/or domestic carbon pricing to meet their NDC commitments. These 97 Parties represent 58 percent of global GHG emissions. (Santikarn et al., 2020: 86).

At the moment policy leans heavily towards carbon trading, we would argue the relative emphasis on carbon trading should be opposed and greater emphasis should be placed on carbon taxes within a global approach. A brief reprise of the dominant system since Kyoto clarifies the claim.

4. Carbon trading: Kyoto, Paris and after

Kyoto set the conditions for three emissions reduction implementation mechanisms based around cooperation in the form of trade in permits and finance for credits:

1. Trading of units of authorised emissions between eligible participants within assigned GHG quotas.
2. Emissions reduction credits earned by Annex 1 parties for "joint implementation" activity (financing reductions in another Annex 1 party).
3. Financing emissions reduction projects in non-Annex 1 parties in exchange for certified emission reductions (CERs) under the Clean Development Mechanism (CDM).

Mechanisms two and three are variants of offsetting, while mechanism one seeks to harness market processes (and so is a market conforming solution to an environmental problem). Mechanism one or emissions trading systems (ETS) are the most significant for our purposes. Some ETSs have allowed participants to buy CER credits to meet compliance obligations and are "hybrid" systems, but the key underlying feature of an ETS in general is that property rights are created for emissions. What was previously an unpriced by-product of economic activity becomes a commodity and this facilitates "carbon trading".

The basic framework for this synthetic market (i.e. creating a market that did not exist) is simple, emissions are measured and assessed, quotas are set and permits provided. Though most systems operate under the auspices of Kyoto, the economics predates Kyoto and was developed in the 1960s. The basic argument on property rights is attributed to Ronald Coase (1960) and discussion of the system to John Dale and Thomas Crocker. The economic reasoning is simple: use of allocated permits leads to shortage and surplus, so the synthetic market is in effect an induced "secondary market". If entity A (a country or corporation) uses up all of its permits it must enter the market and buy more permits to cover its further emissions. For entity A, permits become a cost providing an incentive for entity A to lower emissions in the future. If entity B has a surplus of permits it can sell them in the market. For entity B, surplus permits become a source of revenue, which also provides an incentive to lower emissions in the future. As such, an emissions permit system creates both demand and supply incentives, works with a price signalling system and seems to foster dynamic efficiency i.e. profit and cost considerations lead to price effects, behavioral change and investment in alternative technologies *all* focused on emissions reduction. In standard environmental economic theory this effect still applies even if the institutional arrangement is asymmetric and the policy mechanism focuses on the demand side, since the main feature of the market is restriction on the number of permits and numbers of permits can steadily be reduced. In principle, this ratcheting periodically lowers the ceiling for maximum emissions in the system and continually induces cost effects that place pressure on participants to respond through dynamic efficiency.

Clearly, for a "cap and trade" carbon market system to function effectively three conditions need to be fulfilled. First, the ceiling on emissions must be aggressive, making permits both a constraint (through allocation) for any individual participant and scarce in general. Second, for a logic of dynamic efficiency to apply, permits must be a significant cost to participants (otherwise buying them is a negligible feature of economic decision making). Third, the system must cover the main emissions producing aspects of economic activity. So if an ETS begins with some sectors it must extend eventually to others. There are many carbon markets around the world, some are international, some are national, some are sub-national – the EU Emissions Trading Scheme (EU ETS), the US state Regional Greenhouse Gas Initiative (RGGI), Quebec Cap-and-Trade – and surveys of them identify numerous problems (e.g. Flachsland et al., 2020; Narassimhan et al., 2018; Newell et al., 2013; Spash, 2010). Real-world situations have not conformed to the three conditions and real-world issues do not reduce to them either. There are core technical and political economy challenges:

- The problem of measuring emissions by economic sector and then allocating permits to entities. Measurement of emissions is easier in some sectors than others. It is easier in sectors comprising a few entities operating at scale and with consistent supply chains, inputs and output, such as electricity generation, steel production and so on, but becomes steadily more complex as an administrative task for other sectors.
- Administration of the system is forward-directed and so needs to estimate numbers of permits for some future duration to enable reasonable foresight and planning for and by entities (in principle expediting emissions reduction-related activity). Though measurement of historic emissions may be more or less precise, the level of future emissions permits is not a simple calculation based on historic emissions. The task is complicated since estimates are contextualised by generalised technological changes (invoking all the problems we outlined in a previous section) and must be commensurate both with some reasonable level of economic activity in the sector and with emissions reduction goals. Lobbying may also occur and sector allocations may be more or less of a negotiation (formal or informal).

Numerous problems have followed in given markets, but the fundamental issue is that the price of permits has never been a major cost to emitters. For example, since its inception in 2005 the EU ETS has been through three periods and is just entering "phase four" in 2021. EU Allowances (EUAs) are parcelled in tradeable units of one tonne of $C0_2$ (or where appropriate some equivalent GHG). Between 2005 and 2008 prices peaked at around €30 $tC0_2$, fell as low as €1 and rarely exceeded €20. Between October 2008 and September 2018 the price never exceeded €20 $tC0_2$, at some points dropped below €3 and was typically less than €10. More recently prices have climbed, fluctuating between €20 and €30 since late 2018 and approached €40 in March 2021. Consider what this means, the "cap" in "cap and trade" may produce some reductions in emissions. For example, the EU-wide cap on emissions from "stationary sites" was set at 1,571,583007 EUAs for 2021 and reduced by 1.74% per year during Phase 3 (2013–2020) and is set to reduce at 2.2% per year during phase 4 (2021–2030) (EC, 2021a). Moreover, in any given jurisdiction various other factors may also lead to reduced emissions in some sectors (notably domestic legislation, political choices and carbon floor prices have led to transitions from coal fired power production in some countries). But the "trade" aspect of "cap and trade" seems extremely unlikely to have played any significant role in incentivising emissions reductions (i.e. inducing dynamic efficiency).

5. From trading to taxes

To be clear, even analysis that claims conditional success for the EU ETS recognize prices are low and total emissions reductions far less than required for climate purposes. For example, Bayer and Aklin (2020) claim that the EU ETS reduced emissions by 3.8% of total EU wide emissions between 2008 and 2016 compared to a world without an EU ETS. This is far short of meaningful reductions. In any case, given the relatively low price of permits, it has remained cheaper for emitters with a shortage of permits to buy permits than it has been for them to take other actions. Moreover, the low price is indicative of a continual problem of surpluses and while this might be acceptable for a brief period during the initial implementation of a carbon trading system it is unacceptable as a perpetual feature of such a system. As such, the design and implementation of carbon trading systems has been mainly a distraction. This is not to say no progress goes on within carbon trading systems and no learning occurs.

For example, the allocation of permits in phase one of the EU ETS was free (they were "grandfathered" rather than "auctioned") and this has reduced from phase to phase. In 2019 43% of permits were free and the plan for phase four anticipates eliminating by 2026 free allocation in sectors which are not vulnerable to relocation of the entity i.e., are not vulnerable to "carbon leakage" (EC, 2021b). However, the expectation is still that more than 6 billion free allocations will be made 2021–2030 (EC, 2021c). Concomitantly, the EU ETS has over the previous three phases extended to cover more than 11,000 "heavy energy using installations" in all EU countries plus Iceland, Liechtenstein and Norway, as well as airline activity between member countries, and now covers over 40% of GHG emissions across the region. Moreover, the EU ETS has responded to surpluses by "back-loading" or holding back permits. This is mainly achieved by delaying auctions and the EU ETS has also developed a "Market Stability Reserve" to which unallocated permits can be transferred, effectively cancelling them from a market perspective (EC, 2021d). The long term aim is also to attempt to align the ETS with the EU "Green New Deal", though how is not yet clear. Still, mechanisms are reactive and have not prevented surpluses accumulating, nor have the methods resulted in significant increases in market prices of EUAs. For example, there was a 2 billion surplus at the end of phase two and a 1.78 billion surplus in 2015. The primary context here is an overhang from the global financial crisis. This confirms an underlying problem of fundamental uncertainty, paralleling that previously noted, since allocation estimates are ultimately dependent on economic forecasting – even though a cap applies. The global financial crisis led to significant disruptions in the stringency of allocations and it seems likely that the Covid-19 pandemic will do the same.

These problems of managing an ETS again merely distract from the basic issue that trade has not and seems unlikely to lead to radical emissions reductions of the kind needed to meet climate goals. There is, furthermore, a final set of issues that combine political economy issues of power and moral issues. As the well-known philosopher Michael Sandel argues, markets enable the outsourcing of moral obligation to reduce excessive greenhouse gas emissions. If the powerful can pay themselves out of this obligation and thus buy the right to pollute legally, the whole point of climate governance is compromised (becoming fragmented in terms of sense of duty). As such, market frameworks reinforce a counterproductive attitude – that nature is a dumping ground for those able to pay (Sandel, 2012: 76). In this context emissions trading undermines the sense of shared sacrifice necessary to expedite future global cooperation on the environment, while also encouraging an instrumental attitude towards nature (Sandel, 2012: 75).

Furthermore, in an ETS system, instead of thinking of emitters as polluters responsible for harm and subject to strict sanction, polluting is "normalised" by economic theory. Moreover, this applies in particular to emitters who receive free allocations – they are effectively rewarded with permits in the name of voluntary economic efficiency. And these emitters are likely to be the largest corporations in sectors where "carbon leakage" is a major problem and few substitutes for emissions producing activity are possible, notably steel. In 2019, Arcelor Mittal was the largest recipient of free allocations in the EU ETS and was effectively saved from more than €1.5 billion in costs. As critics note, free allocation protects existing assets and reduces incentives to invest in alternatives. Large multinationals dominate key heavy energy using sectors and oligopoly tends to be the typical market structure – a situation ripe for manipulation and exercise of power – quite different than the presumption of perfect competition, which lies behind the idea of efficiency on which ETSs depend. And the effect is not just to protect existing assets. By making emissions tradeable assets, financial agents who earn fees from undertaking trading activity and "market making" acquire a vested interest in lobbying to maintain the system, exaggerating its importance and success, irrespective of its underlying underperformance from a climate point of view.

So, carbon trading feeds two sets of interest groups both of which work to reinforce a status quo, and policies of carbon trading reduce calls for more stringent and pervasive carbon taxes. The real-world failure of carbon trading, therefore, provides support for greater focus on carbon taxes, in so far as these enable accelerated change and transfer of resources and activity from problematic sectors, while also enabling social redesign, which to recall our argument from the "facts in waiting" section, is something over which we potentially have greater control *now*, if we so choose. Stringent carbon taxes can be a more effective stepping stone in the context of climate emergency and, since the problem of emissions is global and the problem of emissions reduction requires co-ordination, ought to be administered through a global framework in the post-Paris period and we briefly conclude with this.

6. Conclusion: Global Keynesianism and a GGGT

As the World Bank survey of the many current carbon taxes in existence indicates, carbon taxes have the great advantage of transparency, relative simplicity, flexibility in the sense they readily extend across all kinds of socio-economic activity (carbon production and carbon consumption) and are amenable to direct control by administrating or policymaking constituencies (Santikarn et al., 2020: 29–45; see also McEvoy, 2018). They are something which we have control over *now* if we choose to take it and they can set in train different possible futures (see Patomäki, 2011, 2010). Carbon taxes set a price on carbon use and can be calibrated in terms of the carbon content or impact of some given activity. They differ from an ETS in that they are not a pricing system set within and supposedly responsive to a cap. While the stringency of the cap is important to the degree of constraint created for a permit trading system, the level of the carbon tax is important to whether in fact a tax is capable of reducing a climate harmful activity. The more stringent the tax then the more of an incentive or deterrent it becomes. Currently, standard theory justifies carbon taxes in a Pigouvian sense of expediting market efficiency, but the urgency implicit to Paris Article 2 (1a) and the IPCC *Global Warming of 1.5^{0}C* report seem to call for something different. With climate goals in mind we need to start thinking of carbon taxes as market disruptive rather than market convenient (see Hickel and Kallis, 2020; Parrique et al., 2019; Gills and Morgan, 2020a, 2020b). It is also important to bear in mind that the purpose of such taxes is not primarily to generate revenue but rather to influence activity, such that climate goals are met. At the same time, of course, revenue does provide a potentially significant source of financing and this can be important in building institutions.

In any case, well-designed carbon taxes can be stringent but not necessarily punitive in terms of discrimination against vulnerable groups, since they can also be designed to recredit, compensate and redistribute. Carbon taxes thus have context and do not function alone, as policy they exist within an overall framework. For example, not only does more need to be done to make taxes bite, more needs to be done to rapidly reverse current subsidies to fossil fuels, something that periodic IEA and OECD data suggests is not happening quickly (e.g. OECD/IEA, 2019). Thereafter, we would argue more needs to be done to link taxes to social redesign, rapid reinvestment and transfer of resources to more sustainable socio-economic activity within what Earth system scientists call "planetary boundaries" (Lenton et al., 2020; Steffen et al., 2018; Rockström et al., 2009). This then implies doing more to align tax policy with "just transitions" (see Newell and Simms, 2020; Stay Grounded, 2021). A carbon tax requires a mechanism, a methodology and an institution and while there is a great deal of work exploring the first two of these (again see Santikarn et al., 2020: 29–45) there is little on the third. Since the ultimate context of policy is a planetary problem, we would suggest a global approach makes most sense. As a preliminary claim we suggest a "global Keynesian" approach for future development.

Global Keynesianism predates but is compatible with the ethos intrinsic to the 1992 UN Earth Summit and the rhetoric if not reality of subsequent institutional development. The term "global Keynesianism" entered the literature in the early 1980s, and to start with was mainly used by critics of the Brandt Report, published in 1980. Advocates of the approach also adopted the term (e.g. Mead, 1989). The Brandt Commission developed the idea of a world civilization and proposed a new international and global economic system (for broader context and issues see Patomäki and Steger, 2010; Patomäki, 2006, 2002; Patomäki and Teivainen, 2004). A key theme of the Brandt Report concerns the urgency of transition away from fossil fuels and to renewable sources of energy (Independent Commission, 1980: 114). The basic ethical principle is that "the biosphere is our common heritage and must be preserved by cooperation" (Independent Commission, 1980: 73). The Report advises, "all nations have to cooperate more urgently in international management of the atmosphere and other *global commons*, and in the prevention of irreversible ecological damage" (Independent Commission, 1980: 283–284, emphasis added). The task is not only to facilitate transition to post-fossil fuel economies, but also to shape the direction, composition, distribution and speed of economies towards more sustainable paths (Patomäki, 2013: 164–193).

Clearly, a GGGT cannot stand alone. It is a policy to expedite transition, but this begs the question of transition from what and to what? As we have noted throughout, carbon emissions are one problem among many conjoint problems and the context of these problems is created by the scale and continued growth of economies, behind which sit mechanisms and interests, both of which have consequences. If we are to really transition beyond "business as usual", therefore, a GGGT must be sensitive to and designed in terms of this recognition. It must be holistic rather than one-dimensional. We turn to making this case in subsequent work. Global Keynesianism argues for a coherent world organizational approach, democratising a world system. We propose a post-Paris global carbon tax authority to administer and co-ordinate GGGT in the spirit of global Keynesianism.

Credit author statement

The authors would like to confirm that they are joint and equal co-authors of this article.

Declaration of competing interest

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

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