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Ecological Crisis, Decarbonisation, and Degrowth: The Dilemmas of Just Petrochemical Transformations¹

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Abstract: In the throes of unfolding climate disaster, we are at a planetary crossroads of profound industrial transformation. This paper argues that tackling the problem of unsustainable growth is crucial in order to mitigate the worst effects of the ecological crisis, and that proposals for decarbonisation, degrowth, and just transitions should be connected. Decarbonisation has become an urgent priority in the global climate race to reach zero emissions by 2050. However, despite increasing net zero pledges from governments, cities, and corporations, the imperative for perpetual economic growth still remains integral to global capitalism. The degrowth movement challenges the dominant paradigm of economic growth and promotes non-marketized ways of living and working, but it remains outside of mainstream economic policies and has little resonance for deindustrialized and marginalized communities. Decarbonisation faces considerable barriers due to embedded interests in fossil fuel-dependent growth. This paper examines one of the key growth obstacles to transitioning away from fossil fuels: the multiscalar problem of petrochemical lock-in, related to growing global demand for carbon-intensive plastics consumption, the use of petrochemicals in green technologies, and regional and local economic dependencies. It focuses on the emblematic case of the petrochemical town of Grangemouth in Scotland, where there is government pressure to pursue growth-led decarbonisation, and local residents and workers have started to question their dependence on fossil fuels, amidst tremendous gaps between local social and economic deprivation and petrochemical industry profits. Rather than considering the need for just transitions only after the loss of industrial jobs, visions for just petrochemical transformations need to be more proactive, speaking to wider degrowth themes of well-being, community participation, and prosperity without extractive growth.

JEL classification (keywords): F64- Environment; F66 Labor; O43- Institutions and Growth; O44- Environment and Growth; P18- Energy, Environment; P48- Political Economy, Energy, Environment; Q5- Environmental Economics.

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1. Introduction

We live in an era of intensifying ecological crisis, on a scale of existential threat to life on the planet—smothered and poisoned by toxic waste, on the brink of climate catastrophe. Crisis has become the norm, overlapping across social, ecological, and economic spheres. Yet despite increasing public attention to crisis there is also fatigue, fanned by the relentless news cycle, not to mention the pandemic. Scientists warn that alarmist accounts about the climate emergency have not been stark enough, and that there will be dire consequences for life on the planet even with substantial international efforts to reduce emissions. Nothing short of unprecedented collective action on multiple scales is required to mitigate the worst effects of the unfolding disaster, which will disproportionately impact marginalized and vulnerable communities. This begs the question: amidst polarized worldviews, crisis fatigue, powerful corporate incumbents, and systemic inequalities and injustices, what kind of planetary collective action is possible?

At this critical juncture, we are poised for a radical industrial transformation, which will require collective reckoning with the limits to growth, including the urgent need for decarbonisation across all industrial sectors. Social and ecological problems are escalating exponentially, and we have already reached a state of ecological overshoot, beyond the sustainable threshold of the Earth, as the *Limits to Growth* (Meadows, Randers, and Meadows 2004) authors argued in their 30-year update to the classic 1972 text. This paper argues that the global momentum for decarbonisation and just transitions needs to be linked with degrowth proposals that challenge the dominant paradigm of perpetual economic growth. Investments in green technologies will not be enough to reduce greenhouse gas emissions, without also reducing carbon-intensive consumption. Furthermore, many green technologies have toxic environmental justice consequences, particularly for precarious workers and communities in the Global South, so the uneven social and ecological costs of growth-driven solutions need to be considered (Stavis and Felli 2020; Paul and Gebrial 2021). At the same time, the degrowth movement needs to confront industrial capitalism head on, rather than avoiding the question of conflict and the politics of just transformations.

Degrowth is a political and ecological movement, with origins in the 1970s «limits to growth» debates, which criticizes the dominant economic growth paradigm and aims to build a future «in which societies will use fewer natural resources and will organize and live differently than today» (D’Alisa et al. 2015, p. 3). Most proposals for degrowth envisage smooth democratic transitions towards «convivial societies who live simply, in common and with less» (D’Alisa et al. 2015, p. 11). Yet these visions of cooperatives, commons, and caring communities seem oddly detached from the politics of industrial capitalism and offer few clues about how systemic transition will occur in practice. There is a conscious reason for this omission. Instead of aiming to change the dominant capitalist system, the aim of many degrowth movements is to create new worlds on the periphery of capitalism, post-capitalist islands that eventually affect continents (Escobar 2018, p. 174). However, it is important to extend degrowth proposals towards changing the existing system, alongside creating the new ones.

The idea of degrowth is somewhat misleading, since it does not advocate for zero growth or negative growth. The term itself is a provocation, firmly rejecting the mantra of growth for growth’s sake and GDP growth. In a move that arguably overstretchers the concept, degrowth scholars promote «flourishing» rather than «growth» of the kinds of economies and practices that they would like to encourage, for example in healthcare, education, and renewable energy (D’Alisa et al. 2015, p. 5). More convincingly, in *The Case for Degrowth*, Kallis et al. (2020, pp. 11-12) take aim incisively at the concept of perpetual growth, rather than growth as such, arguing that it is axiomatic that nothing can grow perpetually, yet this expectation has become common sense within mainstream economies. In fact, degrowth proposals resonate with arguments for

sustainable growth, including the economist Mariana Mazzucato's (2018) thesis in *The Value of Everything* that the relentless pursuit of economic growth within capitalism has been fostered by misguided societal narratives about corporate wealth creation. These stories enable corporations to continue apace with value destruction, rather than value creation, and hence there is a need to reconsider the meaning of value within societies and economies. In other words, it is not only a question about growth, but about what kind of growth is productive, equitable, and sustainable.

It is also a question of collective capacity and will, across irreconcilable differences of polarized worldviews. The climate denial and violent post-truth politics of Trump and Bolsonaro stand diametrically opposed to the groundswell of climate activism, the Black Lives Matter protests, and other grassroots movements for social, racial, and environmental justice. On the one hand, these struggles echo Polanyi's (1944) concept of «double movement», a dynamic underlying the «great transformation» of the Industrial Revolution between the destructive forces of capitalism and the salving counterforces of civil society. On the other hand, increasing social polarization has overturned and fragmented age-old solidarities. There is another pernicious obstacle, too, in these times of competing pressures: what David Wallace-Wells (2018, p. 234) calls the «double-talk» around climate change, for example the Canadian Prime Minister Justin Trudeau declaring a climate emergency one day and approving a new oil pipeline the next.

How can we heal these differences, to do the necessary collective work to mend the future of our communities and life on our planet? This paper will first make the case for reckoning with degrowth as a proposal for tackling ecological and economic crises, including its possibilities as well as limitations. Next, it will evaluate the importance of considering degrowth in relation to decarbonisation, where a rhetoric of degrowth, at least in terms of advocating a transition away from fossil fuels, has been officially endorsed by policymakers. However, even in this seemingly straightforward case, decarbonisation efforts are thwarted by corporate incumbents through strategies of deflection, delay, and even co-option, in the case of corporate commitments to net zero carbon emissions. Moreover, growth remains so embedded in global capitalism that most «solutions» have focused on channelling investments towards green technologies, rather than on questioning unsustainable consumer markets. The paper then focuses on one of the key growth obstacles to transitioning away from fossil fuels: the multiscale problem of petrochemical lock-in, related to growing global demand for carbon-intensive plastics consumption, the use of petrochemicals in green technologies, and regional and local economic dependencies. The case study of the petrochemical town in Grangemouth will then be discussed, pointing to the emergence of a local labour and environmental politics of refusal of fossil fuel-based expansion, driven not only by increasing environmental concerns but also by social, political, and economic alienation. Finally, the paper argues that connections between workers' calls for just transitions and wider degrowth visions of well-being and commons need to be made, but in advance of the fossil fuel transitions, rather than after job losses. The paper concludes by arguing that tackling unsustainable growth is crucial for decarbonisation, and that alternative visions of work and life from the degrowth movement could help to inspire and motivate calls for just transitions.

2. Reckoning with Degrowth

Degrowth is a heterogeneous movement, and people arrive at it from different positions, whether from the limits to growth, anti-capitalist criticisms of unsustainable development, synergies with autonomous movements in the Global South, or alliances with other forms of environmental justice activism (D'Alisa et al. 2015; Kallis et al. 2020; Martínez-Alier et al. 2009). I have arrived at degrowth laterally, through contemplating the enduring struggles of environmental justice around the world, alongside escalating ecological crisis, which is clearly fuelled by the insatiable drive

within capitalism for expansion and extraction. Challenging the economic growth imperative is important, not only because of planetary limits related to resource scarcity, waste, and living standards, but because so much of it is destructive, for physical and mental health, and all forms of life, with the worst effects on disadvantaged low-income and minority ethnic communities. It is also an existential question. Scientists have recently pronounced that we have underestimated the challenges of avoiding a «ghastly future» marked by climate catastrophe, mass species extinction, and over-consumption, and offer a «cold shower» of stark warnings as a wakeup call for action (Bradshaw et al. 2021). Social scientists should also offer a cold shower about the necessity, rather than desirability, of challenging the pursuit of unsustainable economic growth. Yet they also need to address the practical possibilities for such proposals.

Pursuit is a key word. Is the problem really about growth in itself, or the tireless pursuit of growth for growth's sake? Critics of the degrowth concept argue that it is Eurocentric, too narrowly focused on elite overconsumption, and too negative due to its linguistic implications of rejecting all forms of growth (Drews and Antal 2016; Rodríguez-Labajosa et al. 2019). The philosopher Kate Soper (2020) refers instead to «post-growth» to convey more positive aspects of the idea. The degrowth movement has been particularly controversial because of the economic disparities between the Global North and South. Rodríguez-Labajosa and co-authors (2019) argue that the concept of degrowth has little resonance for people who are living in poverty in the Global South who want to see some growth in opportunities and welfare.

Indeed, after decades of economic stagnation, exacerbated by the 2008 recession and deepened by the pandemic, degrowth is a hard sell for poor and deindustrialized communities around the world (see Huber 2019). In the *Coming of the Postindustrial Society* (Bell 1973), Daniel Bell famously predicted the decline of manufacturing and the rise of the knowledge and information economy. However, Bell's thesis has not delivered on its promise. Nothing has replaced the industrial growth engine of manufacturing on a global scale, and the knowledge and service economy is full of precarious and insecure jobs. Over the past half century, deindustrialization has continued to ravage working class communities, starting in North America and Europe in the 1970s and 1980s, and extending to South America, Africa, China, and other parts of Asia in later decades. The political economist Aaron Benanav has argued in his recent book *Automation and the Future of Work* (2020) that we have witnessed global labour deindustrialization, which he attributes to rising industrial overcapacity rather than automation, leading to a global slowdown of industrial output since the 1970s. As global industrial production has slowed down and stagnated, Benanav argues, the global labour population has grown, resulting in a lower proportion of manufacturing as a share of total employment.

How can the economy be increasingly stagnating, if corporations and the world's richest people are getting richer and richer? Why are there so many billionaires? Degrowth scholars recognize that periods of decline and economic stagnation within capitalism result in increasing workforce exploitation (Blauwhof 2010). However, they fall short of answering how to change capitalism itself; their proposals are anti-capitalist, or post-capitalist, but are fuzzy on questions of revolution or transformation. Mariana Mazzucato's analysis of value extraction versus value creation in the global economy is more useful for examining the failures of capitalism and how it might be reformed, but then again, according to *The Times*, Mazzucato is «the sort of critical friend capitalism needs» (Collins 2018). For many degrowth scholars, «sustainable growth» under capitalism is a contradiction in terms (D'Alisa et al. 2015). As I argue in the following discussion, it is important to engage with tensions between reformist and radical proposals for transformations.

In an essay making the case for degrowth through pandemic times, Nelson and Liegey (2020) write that «degrowth is about a democratic and serene transition toward new models of society where

infinite growth on a finite planet is recognised as neither possible nor desirable». The ease of this kind of vision is what I am uncomfortable with. Given all that we know about capitalism and colonialism, and after centuries of struggles for equality and justice, how could such a transition threatening to overturn the status quo be serene? We have already witnessed the threats to democracy of post-truth politics and divisive populism. Furthermore, the idea of recognising what is neither possible nor desirable also begs the question: what is possible and desirable, and where does that sit alongside what is essential, what is harmful, what is just, and what has unintended consequences? D'Alisa et al. (2015, p. 4) propose an analogy for explaining how degrowth is not about less of the same, but about something different altogether: «The objective is not to make an elephant leaner, but to turn an elephant into a snail». From whose perspective is it possible or desirable to turn an elephant into a snail? In their introduction to their edited book *Towards a Political Economy of Degrowth*, Barca, Chertkovskaya, and Paulsson (2019, p. 6) argue that the weakest spot of the degrowth political project is that it is «perceived to be ideationally driven, that is, not based on the material interests of any particular social constituency». This is what needs to change.

3. Decarbonisation and Degrowth

Within global capitalism in the twenty-first century, the pursuit of perpetual growth remains foundational. Despite intensifying ecological crisis and repeated warnings about the limits to growth, the dominant paradigm of GDP growth has proven remarkably resilient. But if there is any sector in society where there have been widespread calls among powerful stakeholders for degrowth, of sorts, then it is fossil fuels. The reason is the climate emergency, of course, rather than a philosophical rejection of growth as such. In October 2018, the UN Intergovernmental Panel on Climate Change (IPCC) published an alarming report warning that the world needs to cut global emissions by half by 2030 and reach zero emissions by 2050, or else face untold climate catastrophe (Masson-Delmotte et al. 2020). Decarbonisation spells nothing less than the endgame for fossil fuels.

Just as the age of King Coal was surpassed by the age of oil, global capitalism can envisage the end to the age of oil. While oil has so long seemed synonymous with capitalist interests, it is only one fraction of the capitalist market system, and mainstream economists have warned for years that the end of oil is on the horizon. The Economist's November 2016 special report on the future of oil argued that «the world needs to face the prospect of an end to the oil era», citing the challenge of climate change, the prospect of viable alternative energy solutions, and the rise of electric vehicles (The Economist 2016). For decades, the oil industry has funded climate change denial and relied on aggressive lobbying to avoid addressing the issue (Oreskes and Conway 2011; Klein 2019). However, since 2018 the industry has been under increasing public pressure to respond to the escalating climate emergency, partly due to the climate movement, but largely due to climate divestment campaigns and legal requirements for companies to disclose climate risk by financial institutions (since December 2019). In 2020, the United Nations launched its global Race to Zero Campaign and the World Business Council for Sustainable Development set a target of net zero emissions by 2050 for all its members. Several fossil fuel companies, such as BP, Shell and Total, have pledged to become net zero energy companies by 2050 (Coffin 2020; Kusnetz 2020).

It would be naïve to assume that oil and gas corporations have really gotten on board with the transition. They do see decarbonisation as a major threat to business, but in the meantime, they will exploit and profit from what they can before they are forced to quit. Oil and gas companies received enormous bailouts during the first wave of the pandemic in the aftermath of the crude oil crash of April 2020 and lobbied to roll back environmental regulations where possible (Gardiner 2020; Harvey 2020). To support their case, they have relied on renewed arguments that

fossil fuels are an essential industry, providing important energy needs, vital infrastructure and transport, and raw material inputs for making personal protective equipment (Gardiner 2020). Over the past few years, oil companies have also started to hedge their bets on oil by ramping up their petrochemical investments, in order to serve growing plastic markets (see Mah 2021). This move has not gone unchallenged, even among investors. For example, the green investment think tank Carbon Tracker issued a report called «The Future is Not in Plastics» (Carbon Tracker 2020) questioning the oil industry's long-term investment strategy in plastics, which would become stranded assets in the green transition.

The problem with proposals for decarbonisation is that they are enveloped within an economy that is steeped in the paradigm of economic growth and marketization. Thus, decarbonisation is highly marketized. Take corporate commitments to net zero carbon emissions, for example: these rely on dubious future technological possibilities for offsetting carbon emissions, on outsourcing carbon emissions to other countries through cap-and-trade programs, on creative accounting of the balance of emissions and offsets, and ultimately, on kicking the can down the road to the distant time horizon of 2050 (see Coffin 2020; Kusnetz 2020; Watts 2021). This echoes Luigi Pellizzoni's argument (in this issue) that cap-and-trade markets for carbon emissions and other «ecosystem services» constitute a moveable frontier of commodification, which is ultimately self-defeating for the planet.

Degrowth scholars and activists also advocate for decarbonisation and «take issue with fossil fuels not only because of peak oil or climate change, but because a high use of energy supports complex technological systems. Complex systems call for specialized experts and bureaucracies to manage them. They unavoidably lead to non-egalitarian and undemocratic hierarchies» (D'Alisa et al. 2015, p. 8). This seems like an easy get-out. Complex technological systems are undoubtedly a feature of fossil fuel-based economies, but they are also a feature of all modern industrial systems, including clean energy technologies and systems, healthcare systems, information technology, transportation networks, logistical supply chains, and countless other industries. Is the answer to all modern industries that are embedded within capitalism simply a matter of wishing them away, or forcing their extinction? Hubristic faith in technological progress is another prevailing mantra of capitalism, but rejection of technologies altogether is unhelpful and impractical.

Degrowth proposals sit most comfortably in post-capitalist alternative economies of cooperatives, commons, and urban gardens. This aligns with the philosophical position among many degrowth scholars that, rather than emerging from the old system, as Marx and Gramsci predicted, alternatives to capitalism will emerge from capitalism's periphery (Escobar 2018). While this position creates generative spaces for exploring degrowth alternatives, it skirts around the juggernaut of capitalist industrial economies, where the reigning paradigm of economic growth is in full force and desperately in need of stronger countervailing paradigms.

Without imagining the practical realities, dilemmas, and stakes of transformation, then radical alternative imaginaries of degrowth seem only fantastical. Thus, the rest of this paper will look more closely at a sticking point for the transition away from fossil fuels: the petrochemical sector.

4. The Multiscalar Problem of Petrochemical Lock-in

One of the key political and economic problems for decarbonisation, across multiple scales, is petrochemical lock-in. On a global scale, the world is locked into a system driven by the imperative for expansion and consumption of plastics, which are ubiquitous in modern life. The majority of petrochemicals are derived from oil and gas, and plastics account for 80% of petrochemical end

markets. (International Energy Agency 2018). Many petrochemical products are essential to modern life, found in cars, computers, medical equipment, wind turbine blades, and thousands of everyday products and infrastructure, thus dismantling the petrochemical sector is not feasible. However, the biggest plastic end market is for single-use plastic packaging (40% globally), which is where there has been pressure among anti-plastic movement for bans and reductions (Azoulay et al. 2019). The petrochemical industry is the biggest industrial consumer of fossil fuels, and the third largest industrial emitter of greenhouse gas emissions (International Energy Agency 2018). The International Energy Agency forecasts that plastics will be the main driver of oil demand in the future, rising from 14% today to 45% by 2050 (International Energy Agency 2018). This is only set to rise with increasing global consumption of plastics. In the face of climate investment risk, many oil majors have diversified their industrial strategies by focusing on petrochemical expansion.

The plastics industry has been under intense pressure due to concerns about marine plastic waste, with a number of single-use plastic bans and circular economy recycling policies in effect. However, industry analysts insist that growth in plastic markets will remain unaffected, due to increasing global demand for plastic consumer goods, particularly in the Global South, combined with rising demand for plastics in green technologies, such as electric vehicles (International Energy Agency 2018). While plastics are recognised to be carbon-intensive and toxic, emitting greenhouse gases and posing health risks throughout all stages of their production and use (Azoulay et al. 2018; Hamilton et al. 2018), they are also seen as part of the solution to climate change (Bauer et al. 2019). Not only are plastics found in green technologies, but their lightweight qualities improve energy and fuel efficiency in packaging, building, and transportation. At least, industry frequently makes these climate-friendly claims about plastics (Clapp 2012). The coronavirus pandemic has only added to perceptions of plastics as essential for modern life, due to their role in sanitation and medical equipment.

Plastics and petrochemicals are positioned as exceptions in green transitions because they use fossil fuels as raw material feedstocks, rather than only combusting them. The industry's reliance on fossil fuels is difficult to replace, especially given current scales of production and consumption (International Energy Agency 2018). The use of bio feedstocks (raw materials for industrial production) such as sugar and biomass are difficult to scale and pose their own negative social and ecological consequences. The use of recycled plastics instead of «virgin» fossil fuels as feedstocks also pose carbon-intensive and toxic problems, due to the vast scales and processes required (see Mah 2021). Material substitutions for plastics, such as paper, glass, or metals, also have carbon intensity and environmental justice issues with large-scale demands.

Across different regional scales, petrochemical production is locked into vast infrastructures of integrated petrochemical and refinery complexes, oil and gas pipelines, and logistical networks. On local scales, many cities and communities around the world have developed around economies that are dependent on oil and petrochemical production. This has resulted in a different kind of petrochemical lock-in that is embedded in local contexts, evident in conflicts over the jobs-versus-environment dilemma, and in bitter struggles for environmental justice in polluted fenceline petrochemical communities. Around the world, minority, low income, and working-class communities face the heaviest burdens of petrochemical pollution (Barca 2014; Auyero and Swistun 2009; Wright 2003). These trends have been widely documented in cases around the world, including recent research from the European Research Council-funded project «Toxic Expertise: Environmental Justice and the Global Petrochemical Industry» (2015-2020), which I led with a team of researchers, including case studies in China, the US, Belgium, Italy, and the UK (Davies 2018; Feltrin and Sacchetto 2021; Mah and Wang 2019; Verbeek 2020).

The comparative, multi-site research from the Toxic Expertise project revealed that multiscale battles over how to transform this polluting-yet-essential industry have started to emerge, combining longstanding concerns about unjust toxic exposures with broader questions of decarbonisation, climate injustice, and toxic colonialism (Mah, forthcoming). However, decarbonisation remains an elusive objective, despite increasing institutional targets and commitments to reach net zero carbon emissions by 2050. Furthermore, given the primacy of economic growth within mainstream policy, degrowth is not really on the table. Yet there have been signs of change, with rising pressures for all government, cities, and institutions to commit to net zero targets, and for just transition policies to secure the livelihoods of workers and communities in the shift to sustainable production. Within this context, alongside the erosion of industrial relations in places where industry has long had a strong relationship with workers and communities, such as the case of Grangemouth in Scotland, a local politics of fossil fuel refusal has started to emerge.

5. «Who Benefits?» The Turn Against Fossil Fuel Expansion in Grangemouth

In October 2020, climate activists from Extinction Rebellion blockaded the entrance to the INEOS petrochemical and refinery complex at Grangemouth in Scotland. As the country's largest polluter, the petrochemical giant poses a major hurdle for the Scottish Government's 2019 commitment to reach net zero carbon emissions by 2045. But until recently, Grangemouth has been more known for organized labour protests than environmental protests. Grangemouth was formerly an oil and petrochemical boom town dominated by British Petroleum (BP). At its peak of employment in the 1960s, the petrochemical and refinery complex employed over 5,500 people, compared with 1,300 employees today, and the town and company enjoyed a positive reputation (Phillimore et al. 2007; INEOS 2020a). In the 1970s and 1980s the industry went into decline, and the jobs and benefits for the community began to dwindle. In 2005, the petrochemical newcomer INEOS, owned by self-made entrepreneur Jim Ratcliffe, bought the Grangemouth refinery and petrochemical complex from BP. INEOS brought in a new style of corporate governance, further eroding the social contract with the community that had been slowly declining with BP (Lyon 2017a; Feltrin 2020). Since then, INEOS has risen into the top ten global petrochemical companies, borrowing tools from venture capitalism by buying «unloved» petrochemical assets from major oil and gas companies and effectively flipping them.

In 2019, the Toxic Expertise research team conducted research in Grangemouth, including three focus groups and ten semi-structured interviews with local workers, residents, local authority representatives, and environmental activists (see Feltrin 2020). Residents described their increasing frustration of living with noxious smells, flaring, noise pollution, and the ever-present risk of a major industrial disaster, in the shadow of a behemoth industry but with no benefits to the community. At the time of our research, Grangemouth included five of the most deprived areas in Scotland, while INEOS CEO Jim Ratcliffe was the UK's richest person. The gap between such extreme wealth and local deprivation has been exacerbated by the lack of employment opportunities for local people at the plant. The town has experienced significant labour deindustrialization despite the continuing expansion of industry (Feltrin 2020; Benanav 2020). Rather than direct, unionized employees, many workers in manufacturing are outsourced agency and contract workers, and much of the work involves higher levels of qualification than in the past, including work with computers, sophisticated machinery, and complex supply chains. One local resident described the feeling of alienation from the plant as follows: «You know, people have got depression. That's one that's associated to it because you open your back window and there's the biggest industry in the world and you can't get near it» (interview, October 2019).

The case of Grangemouth illustrates the changing role of organized labour and industrial towns in challenging new modes of petrochemical expansion in the 21st century. From the outset, Jim Ratcliffe's plans for aggressive industrial restructuring were met with resistance from organized labour. In 2008 the unionized Unite workers at Grangemouth went on strike for two days to protect their pensions, and INEOS was forced to back down. As Ratcliffe and INEOS communications specialist Ursula Heath wrote in *The Alchemists* (2018, p. 176), a corporate autobiographical book about the first twenty years of INEOS: «it would be a war with more battles before victory. While waiting for what he (Ratcliffe) knew would be an inevitable second confrontation, he went about quietly putting mechanisms in place to reduce the union's power».

During the 2013 industrial dispute, INEOS effectively blackmailed the union, threatening to close down the plant if the workers did not accept the withdrawal of their final salary pension scheme, a three-year freeze on wages and industrial action, and other compromises in their conditions (Lyon 2017a). The union capitulated, and workers had to reapply for their old jobs, losing two leading shop stewards and 30-40% of their directly employed workforce. However, instead of opening up job opportunities in the deprived local community, due to the skills gap, INEOS hired new workers from further afield in the UK, and existing employees worked overtime. As a local resident put in, «what we have now is what we refer to as DIDOs or Drive In and Drive Out. People drive into work and they drive out at night. They take their well-earned cash with them and they spend it elsewhere» (interview, October 2019). At the end of the three year no-strike period in 2017, INEOS derecognised the union, but it was reinstated again following a recognition agreement ballot with an overwhelming «yes» vote in October 2018.

Mark Lyon, the Unite trade union convenor, was sacked after the strike in 2013, and wrote a book *The Battle of Grangemouth* (2017a) detailing workers' accounts of the struggle. In an interview published in the journal *Soundings* (Lyon 2017b, p. 63), Lyon reflected that the most likely reason that INEOS was provoked into derecognition in 2017 was because «the union was calling for the Scottish government to intervene in the proposed sale of the BP Forties Pipeline to INEOS, on the grounds that it was irresponsible to allow the pipeline to be controlled by INEOS after all that had happened». Historically, the position of petrochemical workers on environmental issues in Grangemouth has been ambivalent, given the town's dependence on the industry. As Lyon explained: «You find yourself very conflicted. It's harder to be an ecowarrior when you are defending jobs, wages and conditions in an oil refinery... there are the times when you really have to hold your nose - like when you go to the government and ask them to look again at the carbon floor tax» (p. 70). Another worker echoed this point, with a sense of bitterness: «There was stuff that we did, so a policy conference on emissions and... we did stuff with the taxation of fuel and even British Ports. Effectively, we lobbied on behalf of the companies and the industry and it suited the company for us to do that» (interview, October 2019).

Workers' attitudes towards oil and gas have started to shift, especially in relation to future extraction. Partly, this relates to the sense of betrayal and mistrust after the crushing defeat of the union in 2013. However, Lyon (2017b, p. 69) argues that the union's opposition to fracking relates to wider concerns about the risks:

people have said to us «do you think that if industrial relations were still alright, and none of those problems had happened, you would be looking at fracking in a different way - in the way you have looked at other difficult issues in the past?» Is this a vindictive stand, and if things had been different you would have supported the company? These kinds of issues are faced by workers in other industries where there are debates over environmental issues versus jobs, and they are always difficult. But I think this is different. Having seen it at first hand I know that it is a terrible process. On some days in Pennsylvania they have had to close down roads because lethal gas leaks have made whole areas unsafe.

A key part of the INEOS vision has been based on the prospect of fracking shale gas in the UK, as a cheap raw material feedstock, motivated by the success of the US shale gas boom and by declining North Sea reserves. INEOS is the largest holder of UK fracking licenses and has lobbied local and national governments extensively to open up fracking exploration. While fracking has gone ahead in England, the Scottish government announced a moratorium on fracking in 2015. Thus in 2016, INEOS took the pioneering step of shipping US shale gas to Europe, in the world's largest liquefied natural gas (LNG) multi gas carrier, with the support of an £8 million Scottish government grant and a £230 million UK government loan guarantee (INEOS 2016). INEOS has challenged the Scottish government in court over their anti-fracking policy decision, but they lost the case in 2018 (The Scotsman, 2018).

Most workers and residents who we spoke with in Grangemouth were opposed to fracking, saying that fracking risked contaminating water supplies and causing earth tremors, and that fracking licenses brought additional house insurance costs (even with the moratorium on fracking in Scotland, which could be reversed in the future since there is no legislation ban).

One retired worker said that he would support fracking if there was a «100% cast iron guarantee that nothing would go wrong», but the problem was that there was no such assurance (interview, October 2019). However, most agreed that the risks were not worth taking because there would be no benefits to the community. For example, this perspective was evident in the following discussion about fracking with a petrochemical worker:

Worker: There is massive financial benefit to come from it in terms of gas, but who is going to benefit? That's another question. I mean if the benefit is going to go to INEOS and the Scottish government and nothing is going to come to the public then to hell with it.

Interviewer: Yeah, they should keep it in the ground?

Worker: Keep it in the ground, yeah. Because the day is coming anyway, the day is fast approaching when they're going to stop using fossil fuels (interview, October 2019).

An older local resident echoed this view, recognising that the time was running out for fossil fuels, but that none of the benefit would flow to the local community:

And you cannot have an electric plane for any long distance, so all I'm saying is that oil and gas is not going to go away in any of our lifetimes. So, that place (the refinery complex) I think will be okay for fifteen years and my own view is that you can only get benefits to Grangemouth if we have some political representation, which we do not have» (interview, October 2019).

Amidst fragmented trust in industry and government, and uncertainty about the future of the petrochemical industry in Grangemouth, many local people have started to question the town's longstanding dependence on oil and gas. When we asked local residents about what they hoped for the future of Grangemouth, the most common theme was that there needed to be social and economic benefits and political representation for the community, because they had none. As one resident with a passion for local parks put it:

So they've (INEOS) benefitted and we've actually just slowly declined and something needs to be put right and it takes money, so the biggest thing that needs to happen in my view is that we need to be able to create a source of money for the benefit of the community, not for the benefit of industry, but for the benefit in the community to start making the areas, the housing in the town and the green spaces of the town a higher quality than they are to compensate for the negativity that the industry will continue to bring (interview, October 2019).

The resident highlighted the importance of green spaces and housing for the community, which resonates—at least on some levels—with visions of degrowth, by prioritising well-being and ideas of the commons, rather than economic development for its own sake. However, many residents were also nostalgic about the post-war era of growth and stressed the barriers to finding alternative

sources of income beyond the petrochemical industry. One resident, for example, commented: «I think this is a fear of if INEOS moves out, if this guy decides to shut his plant then Grangemouth is stuffed. Well, we're not getting much benefit now, so if they're moving away, I don't know if a lot of people would be employed in this area because they're working further afield» (interview, October 2019). This fear relates to the observation by Dimitri D'Andrea, in this issue, that the «most powerful obstacle... is the unimaginability of a different economic system» (2021). A local environmental campaigner summarized the dilemma of confronting this obstacle as follows:

The young voices that are coming through are saying, «Actually, that's not the kind of work we want to be working in. That's not the future that we want for us, never mind our children». There are a lot of grandparents on the streets as well saying, «This isn't the future we want for our grandchildren. We need to start changing now». But industry is so locked in and we are so locked into that industry (interview, October 2019).

6. Net Zero Growth Contradictions: Linking Degrowth with Just Transitions

Undeterred by the fracking setbacks, INEOS has pushed into conventional fossil fuel expansion. In 2017, INEOS bought the North Sea Pipeline from BP for £200 million, and then acquired the Dong Oil and Gas (North Sea) business for \$1.05 billion and revealed ambitious plans for the first large-scale petrochemical investments in Europe in twenty years (Vaughan 2017). Two years later, INEOS invested \$2 billion in Saudi Aramco Jubail 2, the world's largest petrochemical project (INEOS 2019). INEOS has since come under increasing pressure to decarbonise in the wake of the climate divestment movement and the crude oil crash in 2020. However, it has been a laggard in the push for net zero emissions commitments across the industry, making only vague commitments, such as launching a new hydrogen business «in support of the drive towards a zero-carbon future» (INEOS 2020b).

In July 2020, the Scottish and UK Governments announced a £90 million Growth Deal package for the Falkirk-Grangemouth Investment Zone, focusing on innovative technology towards addressing climate change and sustainability, the 11th such package offered to local regions in the UK since they were launched in 2014 (Falkirk Council 2020). We spoke with an economic development officer in Falkirk who had worked on putting together the bid. She explained that the Growth Deal is like a town's version of a city deal, and one of the focuses of the bid would be looking towards net zero carbon in Grangemouth by 2050. The flagship project would be a centre of excellence in biotechnology:

This is about the proof of concept and taking the technology to the next stage. We have the opportunity to do those sorts of things in Grangemouth. There are a lot of chemical industry processes you wouldn't want to do within a university campus, but you can do it right in the middle of industry and particularly industry that has been established, so that's probably going to be co-allocated with INEOS or the chemical plants, or somewhere like that (interview, economic development officer, Falkirk, October 2019).

The centre for excellence would involve spinoff industries, as well as a separate campus within INEOS to explore carbon capture and utilisation technologies, which would «diversify the industry into cleaner technologies». She cited a recent INEOS announcement that the company planned to pronounce a new type of plastic that would be made from 50% renewable raw materials, and that they were also investing in more efficient waste recycling. Meanwhile, they would conduct a feasibility study for community energy based on solar power. In other words, as the name «Growth Deal» suggests, the plans are about investing in green technological solutions in partnership with industry, rather than more radical transformation involving shifting away from fossil fuel dependence.

A local environmentalist had this to say about the Growth Deal proposal:

The Scottish Government still want it to be oil driven but again, it can't be for our future, so we can invest in that centre of excellence for the last bit of oil, or we could put that investment into the transition to renewables. The UK Government pays more in subsidies to the oil and gas than they receive in taxes, so they get some taxes from it, but they pay more than that and what they would say at the moment is to keep cars running and keep planes flying... ultimately that Plant will have to go, but the thing is we should be planning for that transition now, rather than trying to make that a centre of excellence that then becomes, well actually nobody wants to work there because there is no future in jobs in oil and gas, but they want to get the last bit out of it (interview, October 2019).

The terminology of the Growth Deal, and the inclusion of a focus on achieving growth-driven net zero carbon emissions, sounds like a watered-down version of proposals for a Green New Deal. In contrast with degrowth, proposals for the Green New Deal offer a rosier picture of growth alongside decarbonisation. In the short 2019 film “A Message from the Future with Alexandria Ocasio-Cortez», co-produced with Naomi Klein, US Congresswoman Ocasio-Cortez narrates a story set in the future, after a Green New Deal has transformed the American economy, taking bold steps to save the planet (Klein 2019). The imagined future includes Medicare for all, good green jobs with high salaries for former oil workers, people learning from indigenous communities about how to restore the land, and teachers and health workers who receive decent pay for their valuable low-carbon work. It's a hopeful vision of a future that seems so reasonable, so simple, but with the assumption that there will be a smooth and just transition from dirty to clean jobs, involving sustainable growth rather than decline and struggle.

Green New Deal proposals relate to calls for «just transitions», a concept that has origins in the labour movement, based on the idea that energy transitions to a decarbonized economy need to protect livelihoods, and overcome conflicts between jobs and the environment (Lawhon and McCreary 2020; Morena et al. 2020; Stevis and Felli 2020). The concept of «just transitions» has gained official recognition, inscribed in official UN climate change discussions at the Katowice Climate Conference (COP24) in Polish coal country, which has been dubbed the «Just Transition COP» (Morena et al. 2020). However, if just transitions take the politics of transition more seriously than degrowth, then they (for the most part) offer fewer radical visions of alternative economies and ways of living. For example, Ciplet and Harrison (2020, p. 439) argue that «scholars have treated ‘just transitions’ in an aspirational and uncritical way, neglecting to address the conflicts that do or could arise between sustainability and justice goals or among justice goals themselves in planning and activism». Similarly, Clarke and Lipsig-Mummé (2020, p. 351) contend that most proposals for just transitions within the labour movement are confined to variants of ecological modernisation, aligning with green growth narratives. Yet they also suggest that «a more proactive transformative strategy opening up an alternative eco-socialist vision for the future is emerging», pointing to the example of construction workers in Glasgow opposing building for building's sake.

Scholars and activists have also drawn attention to the problem that Green New Deals in the US, UK, and Europe promise green jobs for workers in their own countries, while ignoring the toxic consequences of green energy supply chains for precarious workers and marginalized communities in the Global South, which are compounded by climate injustices (Paul and Gebrial 2021; Stevis and Felli 2020; Taylor and Paul 2019). Stevis and Felli (2020) make a case for a «planetary just transition» that aims for greater inclusiveness and justice across different scales and temporalities. Similarly, a number of scholars and activists argue that there needs to be an inclusive Global Green New Deal with more radical transformation, including degrowth (Paul and Gebrial 2021; Taylor and Paul 2019). The perpetual displacement of harm underscores the limitation of the widely used environmental justice concept of the «sacrifice zone» (Lerner 2010) to describe contaminated fenceline communities. As environmental justice scholar Pellow (2018, p. 17) argues, «entire

populations are viewed as expendable (within society), not just particular, localized communities and spaces. The implication of a ‘sacrifice zone’ is that one could presumably move away to safety, but the implication of expendability is that there is no escape».

The Scottish Government established a Just Transition Commission in 2018 to help with their target to achieve net zero emissions, and oil, gas, and petrochemical workers are identified as specific groups of employees that would be directly affected by a green transition (Scottish Government 2021). In November 2020, the oil refinery Petroineos in Grangemouth, jointly owned by PetroChina and INEOS, announced that 200 jobs were at risk, which would reduce the workforce from 650 down to 450 workers, due to low demand for crude oil. The Scottish Government and the Scottish Green Party called for a just transition to support the redundant workers, but Unite opposed the job cuts, calling them «pre-mature» (Trimble 2020). Calls for a just transition are necessary to protect, assist, and reskill workers in difficult times of transition, but they offer little consolation when there is no clear alternative vision of the future.

In many ways, the question of a just transition for Grangemouth has already been bypassed, as the community has already witnessed decades of labour deindustrialization and social and economic decline, but without new green jobs or another basis for employment. Another problem at the local level in Grangemouth is that the idea of the just transition is not yet a topic of discussion while the petrochemical industry is still prospering, even if there are so few jobs in the industry for local people. Unlike the refinery, which followed in the footsteps of a number of other refinery closures around the world after the crude oil crash and decarbonisation drive in 2020, the petrochemical complex is positioned more favourably to weather economic storms, poised for growth in plastics markets and green technologies, at least in the next few years.

7. Conclusion

The multiscale problem of petrochemical lock-in exemplifies the green growth contradiction at the heart of the global capitalist climate race to zero emissions. We do not stand a chance of mitigating the worst effects of climate catastrophe without curbing unsustainable resource extraction and carbon-intensive consumption. Just transitions are important to protect workers and livelihoods around the world, but these need to offer meaningful visions of alternative futures for local communities as well as workers. How will deprived petrochemical communities like Grangemouth fare in green transitions, already stripped of so many community resources, capacities and solidarities, and what kind of future could they practically hope for, especially with such low trust in public authorities? Rather than considering the need for just transitions only after the loss of industrial jobs, visions for just petrochemical transformations need to be more proactive, speaking to wider degrowth themes of well-being, commons, community participation, and prosperity without extractive growth. They also need to consider the interconnected planetary scale of ecological crisis, and the consequences for shifting toxic pollution, industrial hazards, and dangerous jobs to other marginalized communities around the world.

The global momentum behind decarbonisation is critical for tackling the climate emergency, driving far-reaching targets, actions, and investments in renewals. However, decarbonisation risks deflection and co-option by corporate incumbents and relies too heavily on growth-driven investments in green technologies with environmental justice consequences, rather than the difficult work of tackling the dilemmas of petrochemical lock-in. Degrowth offers an important but neglected perspective on debates about decarbonisation and just transitions, which both remain premised on GDP growth. Yet degrowth visions of a smooth and democratic green transition away from dependency on growth avoid confronting practical dilemmas and conflicts

of radical industrial transformation. Just transition policies and debates address some of these issues, aiming to resolve conflicts between jobs and the environment by safeguarding the livelihoods of workers and communities, but remain constrained by green growth contradictions. To confront the climate emergency, these perspectives should be brought together to counterbalance their respective limitations, but they should also be extended to address the multiscale implications of industrial transformations, particularly the consequences of displacing harm to the most vulnerable populations around the world.

Degrowth proposals for alternative ways of living and working have gained traction among many activists and communities, particularly during the first wave of the pandemic, but they remain marginal in mainstream and everyday discourses. While degrowth has its limitations and detractors, it also has incredible strength, through offering a vision of well-being that does not rely on the endless pursuit of growth. The task ahead is to extend the political project of degrowth more tangibly and practically within struggles over decarbonisation and just transitions, across multiple scales. This will mean seeking alliances and common ground across differences, and possibly finding new kinds of language that redefine growth (see Rodríguez-Labajos et al 2019; Mazzucato 2018; Soper 2020). There are considerable risks to underestimating the dangers of unchecked capitalist expansion and the co-option and rollback of decarbonisation agendas. The dilemma between different courses of action, and its resolution, lies in the gap between dominant and alternative narratives, and between highly unequal social and ecological consequences of industrial transformations.

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