Universität Basel
Philosophisch-Historische Fakultät

N° 07
2023

Democratising the forces of re/production.
AI planning as sensing apparatus for a degrowth economy

Simon Schaupp

Basler Arbeitspapiere zur Soziologie
Basel Working Papers in Sociology

DOI: 10.31235/osf.io/69bzg

Herausgegeben durch / **published by**:
Seminar für Soziologie, Universität Basel
Seminar for Sociology, University of Basel

Gestaltung / **Design**: Heidi Franke

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Introduction

The ecological crisis is omnipresent. Catastrophic climate change and the sixth mass extinction are threatening the possibility of life as we know it on planet earth. Yet, national and international political institutions seem structurally incapable to effectively address the causes of destruction (Wainwright and Mann, 2019). On the contrary, fossil fuel subsidies continue to grow globally and in 2022 skyrocketed to more than USD 1 trillion (IEA, 2023). In the absence of politico-economic change, efforts for sustainability hope for technical solutions like renewable energy technologies, carbon sequestration or geoengineering. Such "techno-solutionism" has been heavily criticised by degrowth scholars (e.g. Hickel, 2020; Latouche, 2009; Saito, 2022; Schmelzer et al., 2022). Firstly, they emphasise that no large-scale forms of carbon sequestration have been developed and that geoengineering would produce potentially disastrous side-effects. Secondly, they emphasise that even if a complete shift towards renewable energies would happen – of which there is currently no sign – this would not be able to mitigate the climate crisis as economic growth is necessarily coupled to resource- and energy throughput. Meta studies could not find any evidence for the possibility of absolutely decoupling economic growth from environmental destruction (Hickel and Kallis, 2020). Therefore, degrowth argues for a deindustrialisation and localisation of the economy with an emphasis on practices of commoning. The stance of degrowth on technology is ambivalent with some researchers identifying the technologies of industrialism as the source of the ecological crisis while others argue that digital technologies and especially AI could be important tools in a post-growth economy. However, the dominant stance in the degrowth literature is one of techno-pessimism (Vetter, 2018).

This chapter contributes to the discussion on the role of technology for degrowth by exploring the Marxian concept of productive forces. It argues against a techno-deterministic understanding of the concept present in both the opposing camps of ecomodernism and degrowth. Instead, it suggests an interpretation of productive forces as the totality of what human beings are able to do. This definition focusses on positive and negative *potentials* instead of the current technological state of the art. This emphasis of potentials makes the concept of productive forces more suitable for an ecological politics than the term technology, which is rooted in what currently is. Furthermore, the emphasis on potentials makes it possible to systematically identify the political and not merely technical nature of the productive forces. Such a perspective allows for a more precise critique of environmentally destructive technologies that does not fall into the trap of technological fetishism, i.e. turning technology itself into the subject behind the catastrophe.

Building on ecological and feminist Marxism, environmental destruction can instead be attributed to the separation between the spheres of production and reproduction. Technological tools suitable for a socio-ecological transition must therefore be able to transcend this separation, becoming *forces of re/production*. Such a possibility will be evaluated here with regard to AI-based planning technologies. These can, the chapter argues, become a *sensing-apparatus* and thereby reconnect production to its social and ecological basis. This addresses an important gap in the degrowth literature. Thus, Durand et al. (2023) note that almost all concepts of degrowth imply some kind of economic planning but do not spell out the concrete ways in which this would be realised. This gap is so important because it is the very

notion of a *planned* transition that distinguishes degrowth from recession (degrowth by design instead of degrowth by disaster). Therefore, the question of feasibility of degrowth is also and maybe even primarily a question of the feasibility of democratic economic planning. This chapter aims to provide some basic consideration of this feasibility by reviewing approaches of digital democratic planning and participatory integrative planning. Thereby, it also hopes to contribute to easing the tensions between techno-optimistic and techno-pessimistic camps in the debate on the ecological crisis.

Forces of production

Discussions of the concept "forces of production" is intrinsically connected to the *contradictions* that are allegedly inherent to these forces. The first version formulates these contradictions as the source of progress the second one as the source of destruction. The first version is present in an orthodox interpretation of Marx writings. It is mainly based on a passage from *The Poverty of Philosophy*, in which Marx (1847: 166) writes "The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist." This implies a techno-determinist understanding of history being driven by the development of the means of production In this understanding, "[a]t a certain stage in their development, the material productive forces of society come into conflict with the existing relations of production" (Engels, 1859: 263). Passages like these have been interpreted in the sense that technological development is the primary or "objective" cause of social progress and revolutionary shifts. However, technological determinism is not specific to Marxism, instead the mainstream messianic belief that the future will bring technologies to effectively draw CO2 from the atmosphere and produce environmentally neutral energy surpasses any Bolshevik teleology.

The second notion of an inherent contradiction in the forces of production claims the opposite. It is brought forward by environmentalist and feminist scholars who argue that the forces of production are actually forces of destruction as their development destroys the very possibility of life on earth (e.g. Barca, 2020; Caffentzis and Federici, 2014; Mellor, 1992). A current example is Saito's argument that Marx' theory of productive forces should be abandoned and an eco-socialist development of technology would have to "start from scratch in many cases" (Saito, 2022: 158).

Both of these opposing approaches share what could be called a "concretist" interpretation of the concept of productive forces. This interpretation equals "forces of production" with the totality of presently available technology or "means of production". However, Marx' writing can also be interpreted very differently. While he does differentiate *analytically* between means of production and relations of production, empirically those were always intertwined. Thus, the means of production do not realize what is technically possible but what is necessary for increasing profits. Thus, already in *The Poverty of Philosophy,* the text commonly referenced as proof for his technological determinism, Marx writes that "the productive forces have been developed by virtue of [the] system of class antagonisms" (Marx, 1847: 132). This means that technology itself is a product of social relations and the primary cause of progress are social struggles, not technological development. While his earlier writings do admittedly allow for a techno-determinist interpretations, Marx explicitly distanced himself from such a view. However, Soviet leaders from Lenin via Bukharin to Stalin celebrated productive force determinism

as the core of Marxian historical materialism (Mau, 2023: 48–51). This interpretation directly contributed to the reckless productivism of the Soviet Union that aimed at technological progress no matter the human or environmental costs.

Yet, for Marx, productive forces are not tangible things. Just like value as such is never visible itself but still regulates the capitalist mode of production (Pitts, 2020), productive forces do not depend on taking pure and tangible form in order to become historically effective. Productive forces always appear only through the filter of the prevailing relations of production. As soon as they materialize in actual production, they are amalgamated with the relations of production (Lohoff, 1987). Thus, a profit-oriented economy spawns not only questionable products but also production processes that are both inefficient and destructive. This is precisely the tension between productive forces and relations of production. Yet, if productive forces are equalled with empirical technology deployment, the irrationality of capitalist production appears as a property of the level of productive forces reached in the first place, and the capitalist form becomes the essence.

Such a conflation of productive forces and actually existing means of production is implicitly present in current cybersocialist literature that assumes digitalization will lead directly into "postcapitalism" (Mason, 2016) or "fully automated luxury communism" (Bastani, 2019). However, it is also present in parts of the degrowth critique of "industrialism", which transfers to the productive forces themselves the irrationality of large parts of contemporary material production, which springs from the complete subsumption of concrete material production under the abstract logic of exchange value. This erases a possible existence of productive forces beyond capitalism and reduces degrowth to localist "folk politics" (Srnicek and Williams, 2015). Therefore, Durand et al. (2023) suggest that degrowth should engage explicitly with questions of economic planning, including the role of digital technologies. However, their proposal does not engage systematically with the potentials and problems of the various existing approaches to democratic digital planning (DDP). This is what the following sections will do.

Digital Democratic Planning

A central idea of DDP is to replace the market in some aspects or in its totality with AI-based coordination. This follows from a critique of the market as the central mode of resource allocation. According to this critique, markets regulate production through prices, which do not reflect needs but rather solvent demand. Therefore, markets would simultaneously produce undersupply of those in need but without money and environmentally destructive oversupply of those with money. In terms of production, markets would rely on competition and therefore demand continuous cost-cutting of all enterprises which comes at the expense of workers and the environment (Fraser, 2022; O'Connor, 1997). Furthermore, the system of carbon prices and emissions trading is criticised for not providing adequate steering mechanisms (e.g. Buller, 2022).

Therefore, DDP suggests alternative modes of resource allocation that directly couple production to consumption instead of profits but also allow for the systematic accounting of ecological factors (Vettese and Pendergrass, 2022). Most proposals make heavy reference to current logistical systems like those at Walmart (Phillips and Rozworski, 2019), Amazon (Saros, 2014) or service platforms (Muldoon, 2022). These approaches emphasise that algorithmic

management would not be used as a system of surveillance but rather as a "feedback infrastructure" (Jochum and Schaupp, 2022; Morozov, 2019; Saros, 2014). Drawing on ideas of cybernetic management, digital feedbacks are supposed to enable decentralized, self-organized planning both on the level of the labour process and on the level of economic coordination.

In many instances, such a cybernetic mode of control is already present in current algorithmic management: Labour processes are tracked and the data is fed back to the workers themselves, who are tasked with optimizing their own labour processes. Or the resources of a whole company a managed based on real-time data in order to create a continuously adapting, "self-organising" system (Schaupp, 2022). In the DDP literature, such digital infrastructures and indices are supposed to enable a continuous optimization process steering production towards ever-more desirable outcomes. Evaluating the potentials of such digital infrastructures is adequate insofar as it shows that economic planning would be technically possible even on a global scale, which would be a precondition for addressing the ecological crises humanity is facing (Vettese and Pendergrass, 2022). Moreover, it demonstrates potentials for decentralisation and self-organisation instead of centralised planning (Morozov, 2019; Muldoon, 2022; Saros, 2014; Schaupp, 2017). In this regard, DDP partly concedes to the liberal allegation that socialism was bound to fail because in absence of a market prize system it would never be able to match supply and demand (Hayek, 1945). DDP builds on a response by Lange (1967), who argued that computers would be able to solve the necessary economic equations in a way that would produce more efficient results than markets ever could.

In this regard, most suggestions of DDP are not so much contrary to neoclassic economic theories as they claim. Both the principle of matching supply and demand and the (non-)market design are quite compatible with the conception of markets in general equilibrium theory. There, the market is an equation, with one side expressing demand and the other supply. The building blocks of the market are market participants with individual preferences and voluntarily exchange by contract (cf. Stojanović 2022). Digital socialism tries to emulate such markets by replacing money with digital information, this involuntarily overlaps with Hayek's (1945) abstract understanding of markets as "information processing machines". This overlap also leads to a replication of the idea that capitalism can be understood as a mode of allocating commodities through the market. This idea was criticised by Marx as "commodity fetishism" because it presupposes the commodity form as a natural given and veils the relation between capital and labour in the realm of production. For Marx (1976) instead, production and circulation of commodities form an inseparable unity at whose heart lays the capitalist labour process. As Postone (1995) has argued, reducing capitalism to the market is not only inherent to neoclassical thought but also to the Soviet misinterpretation of Marx. Thus, Soviet Marxism reduced the contradiction between forces and relations of production to the opposition between planned production in individual enterprises on one side and an anarchic market on the other side. Thereby, capitalism is reduced to the sphere of circulation. The sphere of production, on the other hand, appeared as a sphere of rational organization, and socialism thus became the generalization of the rationality of production in individual enterprises to society as a whole. The utopia of a socialist society merged with the vision of a total social factory, or, as Lenin (1918)

wrote: “To organize the whole economy on the lines of the postal service.”

Leaving the organisation of production untouched contributed to an authoritarian system of work with disastrous consequences for the Soviet Union. Digital socialism runs the risk of repeating this mistake by focussing only on the sphere of circulation. Thus, for example, the utopia of a “People’s Republic of Walmart” (Phillips and Rozworski, 2019) appears to be an echo of Lenin’s idea of modelling socialist government on the existing German postal service. While Philipps and Rozworski do acknowledge the undemocratic nature of companies like Walmart, the problem of a neglect of the sphere of production remains obvious. The fact that Walmart, Amazon or the various “platform companies” – like the postal service – do not produce anything underlines this problem.

The practical implications of this neglect can be put in more concrete terms by looking at the massive conflicts evolving around precisely those technologies of algorithmic management envisaged as the backbone of DDP. At the turn of the millennium, legal scholar Lawrence Lessig (1999) coined the phrase “code is law” to emphasise this political nature of algorithms as they structure our actions. In the course of the increasing diffusion of digital devices into all areas of life, these “laws” have long ceased to apply only in “cyberspace,” as Lessig assumed. They have spread to all fields of society and are especially ubiquitous in the world of work. As algorithms increasingly assume functions of management, the conflicts inherent in the world of work are also increasingly involve these algorithms. To make their work easier, workers engage in various forms of “technopolitics from below” (Schaupp, 2021) including the manipulation of algorithms in order to decelerate work or even sabotaging digital systems.

There is no reason to assume that algorithms will stop being contested as soon as they are in the service of DDP. On the contrary, if they will become the central instruments in the allocation of goods and services, they will become laws in a more literal sense than ever before. This means measurement itself – like labour credits (as in Cockshott and Cottrell, 1993; Saros, 2014) or “net social benefit” (Albert, 2004) – will become contested terrain. Reducing planning to a task of algorithmic optimization veils this political dimension and thereby forecloses democratic deliberation (cf. Benanav, 2020). However, there are other approaches in the planning debate that do emphasise democracy in the world of work.

Participatory Integrative Planning

While the discussion around the possibilities of digital economic planning has received more attention lately, there is also a longer debate on democratic economic planning that does not refer to technological possibilities. Instead the focus is on institutions that would allow for a participatory design of the whole economy, including both the organisation of work and resource allocation (e.g. Albert, 2004; Devine, 2020; Sutterlütti and Meretz, 2023). These approaches could be summarised under the term Participatory Integrative Planning (PIP). The neglect of work typical for the digital planning strand does not apply to this strand of the debate. Instead, PIP approaches address one of the central problems of the debate around sustainable work. The sustainable work approach acknowledges that strengthening workplace co-determination contra a mere profit-orientation would be a necessary but not sufficient step towards a socio-

ecological transformation. It is not sufficient because the outcomes of workplace co-determination regularly conflict with the interests of external stakeholders especially with regard to the environmental effects of production (Jochum et al., 2019). PIP could offer a way out of this dilemma as it spells out concrete suggestions on how to combine democracy at the workplace level and societal economic democracy.

Beyond questions of democracy, PIP could potentially show a way of overcoming the separation of the spheres of production and reproduction. This separation has been identified as the central structural cause for the ecological crisis by various scholars (Barca, 2020; Biesecker and Hofmeister, 2010; O'Connor, 1997). The sphere of reproduction encompasses all types of work that are necessary to maintain life itself. This can be understood in a very broad sense as including the various types of work necessary for reproducing human labour (raising children, education, nursing the elderly and disabled etc.) and the various types of ecological maintenance and reparation work like foresting, recycling or some forms of agriculture. Some scholars also include the building and maintenance of communal infrastructure like railways, roads, electricity systems etc. The commonality of these different types of reproduction work is that they are necessary preconditions for production. However, they are not included into the sphere of production in the sense that they are not organised and paid for by the enterprises that appropriate them. In most cases, they are organised and paid for by state institutions or delegated to unpaid housework. This leads to a structural undermining of reproductive labour which has been identified as a central cause for recurring environmental crisis and crises of care.

The idea of conjoining democracy at the workplace level with society-wide economic democracy would offer a way of reconnecting production and reproduction as it would conjoin the democratic deliberations within and outside the workplace. However, none of the major PIP approaches systematically addresses the realm of reproduction. The neglect of care work in the planning debate has been addressed by various feminist theorists (Chowdhury, 2021; Lutosch, 2022; Ratta, 2020). The almost exclusive focus on productive work is problematized already by the fact that in most societies, care work constitutes for the majority of all work. In Germany, for example, care work accounts for 64 percent of all social work. Eight percent of this work is paid and 56 percent is unpaid (Winker, 2015: 24). More importantly, the focus on productive work repeats the crisis prone separation of production and reproduction. While productive work is at the centre of PIP, care work is treated as following a completely different logic, which cannot be planned because it is too intimate. This repeats the patriarchal myth that care work is not actually work but an act of love. This myth functions as a legitimation for the social subordination of female work and has therefore long been attacked by feminist politics. One prominent example was the campaign "wages against housework" (Federici, 1975). Lutosch (2022) argues that the neglect of care work exposes an underlying problem of the planning debate, namely a decidedly masculine ideal of autonomy. Thus, concepts as distinct as those by Saros (2014) or Sutterlütti and Meretz (2023) share the norm of an able-bodied young male who does not have any caring-responsibility. For her, this is due to an individualistic idea of autonomy implicit in the idea of individual articulation of needs (Saros) or the idea of absolute voluntariness in the choice of work (Sutterlütti and Meretz). Both

approaches classify interferences in these individual spheres as authoritarian or even violent. Against this approach, Lutosch argues for another notion of autonomy that acknowledges the fundamental dependency of all humans on others.

Human beings are not only dependent on other human beings but also on nonhuman nature. This dependency is addressed a bit more systematically in recent planning debates than issues of care (especially Vettese and Pendergrass, 2022). As described above, however, the environmental dimension of the economy is discussed merely as a problem of resource allocation and not as a problem of work. This is inadequate insofar as a degrowth society would have to devote a large share of its labour to reparations in the face of ecological crises. Its economic planning would, as Dyer-Witheford (2022) emphasises have to focus on disaster relief. This includes but is not limited to: building infrastructures for protection against the effects of climate change like floods, heatwaves, wildfires and superstorms; relocating people from areas that have become uninhabitable and mediating social conflicts that result from mass migration; massively expanding the healthcare sector to treat the rapidly increasing diseases and prevent further pandemics; transforming and repairing damaged ecosystems for example in huge reforestation campaigns; massively expanding human labour in agriculture which will necessarily decrease productivity not only due to stopping unsustainably practices but also due to massive loss in biodiversity, especially pollinator insects; There would be many other immensely labour intensive tasks, not the least researching and communicating projected environmental risks and democratically deliberating on adequate forms of adaptation. Thus, in a degrowth economy, the bias of PIP towards productive work might even have to be reversed because the majority of social labour would have to be invested in reproductive work in a very broad sense. To be able to plan this kind of work, however, would require to overcome the localism inherent to many degrowth visions and develop large apparatuses of coordination.

Forces of re/production

The localism inherent to some approaches in degrowth as well as in PIP is inadequate to the global challenges ecological crises like climate change and mass extinction confront humanity with. Neither mitigation nor adaptation to such inherently global crises can be organised on a merely local level. Instead, they require scalable apparatuses of coordination, including institutionalised forms of collaboration and global data-processing infrastructures. An important example for such a global apparatus, whose importance would even increase in a degrowth society, is climate science. The title of Edwards' (2010) groundbreaking history of climate science, describes it as a "vast machine". This vastness is necessary as climate is an inherently global phenomenon. Therefore, weather and climate data have to be collected from as many places on earth as possible. These heterogeneous data then need to be converted into uniform global data sets afterwards. This necessitates networked knowledge infrastructures comprising people, artifacts, and institutions that generate and process specific knowledge about the human and natural world. Such infrastructures include internationally connected weather observatories and their technical equipment such as satellites, but also social networks such as the World Meteorological Organization (WMO) with the World Weather Watch or organizations such as the Intergovernmental Panel on Climate Change (IPCC). Similar apparatuses are the

basis for our knowledge of other ecological crises like mass extinction.

All aspects of the "vast machine" are the result of the development of productive forces. Thus, in *Grundrisse*, Marx (2005) emphasised that beyond technology, social knowledge and forms of collaboration are "immediate productive forces". Therefore, it is the development of the productive forces that enables our knowledge of the various ecological crises. As this knowledge would obviously be essential for planning a degrowth economy, productive force development cannot be abolished per se. Instead, a viable criterion for assessing technologies would be the question *whether or not they can be turned into forces of re/production*, allowing for a reconciliation of production and reproduction. This is clearly not the case for some technologies. The primary example would be technologies that rely on massive combustion of fossil fuels. Burning fossil fuels means releasing solar energy fossilised over millenia in the deep time equivalent of a blink. This destabilises ecosystems beyond repair.

The case is not so clear for digital technologies. Contrary to popular metaphors like the "cloud", these rely an immense amount of energy and very material resources including rare minerals but also immense amounts of water required for cooling data centres (Crawford, 2021). Therefore, the digitalisation of everything constitutes an ecological problem in itself. However, it is reasonable to assume that it would be possible to uphold a certain digital infrastructure without catastrophic environmental consequences. Such an infrastructure would be essential in reconnecting production an reproduction. Through surveying social needs, it would allow for planning production in a way that directly responds to these needs instead of profit incentives. This would make it possible to eliminate a large proportion of environmentally harmful production while upholding a relatively high standard of living. Furthermore, production could be consciously coupled to its ecological basis by drawing on the models of the earth sciences. Thus, the democratic deliberation of various economic options would always entail projections of the ecological effects that would go along with any of these options (cf. Jochum and Schaupp, 2022). This also means that the ecological dimension does not appear as scientifically declared "limits" but rather as socially deliberated boundaries (cf. Brand et al., 2021).

Coming back to the centrality of potentials in understanding productive forces, such an approach would explicitly not mean modelling a sustainable society on currently existing digital companies. Instead, it would mean to build upon the existing technological and social potentials brought forward by the development of the forces of re/production. The ambivalences that this would entail can be surmised by looking at the history of climate science again. Edwards (2010) reconstructs how the components of its "vast machine" developed directly from Cold War military technology and (post-)colonial conditions. Yet, climate science points beyond these deeply problematic origins by enabling new forms of understanding the disaster that we wrought upon our natural environment.

Conclusion

The incapability of political institutions to act in the face of catastrophe has been attributed to the dependence of the capitalist economy to growth. Yet, the absence of economic growth has historically always meant crisis in the form of recession, which goes along with austerity politics at the expense of the most vulnerable populations. To be meaningfully distinguished from recession, degrowth must be based on

economic planning. However, this contradicts the localism and techno-skepticism of large parts of the degrowth literature. This chapter has used a critical interpretation of the concept of productive forces to evaluate the role that AI technologies might play in democratic economic planning for a degrowth economy. It argues against equating productive forces with currently existing technology and instead understanding it as the totality of what humanity is able to do. The whole critical potential of the term rests on the understanding that this is *not* the same as what they are currently doing.

Building on such an understanding technologies can be assessed with regard to their potential of becoming forces of re/production, i.e. bridging the separation between production and reproduction that lies at the heart of the ecological crises. In this sense, digital planning technologies like those present in the "vast machine" (Edwards 2010) of climate science could be developed into a global sensing apparatus for production. This would allow for reconnecting production to its ecological basis by providing data-based projections of the ecological effects of different available economic plans. Thus, the role of ecology in economic planning would not be one of technocratically prescribed "limits" but rather one of socially deliberated boundaries. Such an approach to AI technology would not amount to modelling economic planning on currently existing digital corporations as some of the DDP approaches suggest. Instead, with Adorno (2006) it would insist on the difference between concretely possible and the current state of affairs.

The non techno-determinist approach to the concept of productive forces presented here would also suggest that a transition to a democratically planned ecological economy would happen neither as a result of technological development – as some DDT approaches imply – nor as a result of scientific arguments – as some degrowth approaches imply. If it will come into being, instead, it will be the result of social conflicts. Therefore, the approach suggested here cannot be restricted to the question of technological possibilities but must include political factors and especially ongoing social struggles. This does not mean to ask what is politically "realistic" but rather to identify political potentials. As Nowak (2021) argues, such an approach could find inspiration in various forms of labour unrest. Following Barca (2020), labour unrest in the sphere of reproductive work would be of particular interest as it rebels immediately against the capitalist erosion of the reproduction of life. Another source of inspiration could be the climate movement. This is not only the biggest global social movement of our time, but also increasingly asserts that markets and the private management of natural resources are part of the problem rather than the solution. Instead, some of its most prominent actors suggests the political form of "climate assemblies" to work out transition plans towards a sustainable economy (Schaupp et al., 2023). In addressing issues of production by including workers from firms affected by transition plans, it transcends the focus on allocation. However, it also transcends the focus on the workplace of classical socialist visions of workers councils by including external stakeholders. Such an emphasis on social struggles could help to overcome the technocratic undertones of some approaches in the planning debate as well as in degrowth.

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