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## Planning for Degrowth: How artificial intelligence and Big Data revitalize the debate on democratic economic planning

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# Planning for Degrowth - How artificial intelligence and Big Data revitalize the debate on democratic economic planning

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# Planning for Degrowth - How artificial intelligence and Big Data revitalize the debate on democratic economic planning

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**Abstract:** The Degrowth movement advocates a radical shift from our capitalist economic system to one based on human needs, planetary boundaries, and economic democracy. The literature, however, often neglects detailing the concrete coordination mechanisms of a Degrowth economy. This paper addresses this gap by proposing democratic economic planning as a potential solution. I delve into historical and contemporary planning debates, examining practical examples and proposals that leverage artificial intelligence and cybernetics for democratic economic planning. I argue that models such as participatory economics (Parecon) or Daniel Saros's planning model align well with Degrowth principles, forming a foundation for further exploration. Effective economic planning requires democratic participation, free information flow, and safeguards against power abuse. Still, open questions on money, trade, democratic institutions, and privacy protection require further investigation.

**Keywords:** Degrowth, economic democracy, economic planning, participatory economics

**JEL codes:** B500, O490, P110, P210, P400

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# 1 Introduction

Amidst increasingly urgent scientific warnings about the dual crises of climate change and biodiversity loss, and in the face of extreme global wealth inequality, calls for a radical transformation of our economic system have grown louder in recent years.

Degrowth is one of these transformative approaches. Its proponents argue that ‘green growth’ or the ‘decoupling’ of GDP growth from resource and energy use is unfeasible and that therefore, the pursuit of growth should no longer be a political objective. Instead, Degrowth stands for the vision of a more democratic and equitable economy that is focused on meeting human needs while respecting planetary boundaries. The ‘Beyond Growth’ conference recently organised by the European Parliament shows that Degrowth has already gained some attention on the highest political levels.

Such a radical transformation requires coordination and planning on a grand scale. However, although Degrowth advocates for participatory and economic democracy, it has yet to provide comprehensive ideas on how a Degrowth economy could be democratically organized.

On the other hand, the concept of economic planning has experienced renewed interest in recent decades, partly due to the potential offered by modern informational technologies, such as Big Data and artificial intelligence (AI). Large capitalist corporations leverage these technologies to control increasingly complex production and delivery networks comprising hundreds of millions of different products. Several authors, including Dyer-Witheford (2013), Morozov (2019), Phillips & Rozworski (2019), and Saros (2014) suggest that these technological infrastructures could be used to facilitate democratic forms of economic planning.

So far, the Degrowth debate and the debate on democratic economic planning existed largely independently from each other. This paper aims to bridge the gap between these two discourses and to look for synergies between the two concepts. The research question guiding this paper is: How can democratic economic planning enhance the degrowth debate?

Section 2 presents the core ideas, objectives, and policies associated with Degrowth. In section 3, I present an overview of economic planning, including the socialist calculation debate and cybernetic management, and assess real-world examples of planning in socialist and capitalist contexts. In section 4, I review three proposals for

democratic planning, looking for intersections and conflicts with Degrowth. In Section 5, the findings of the preceding sections are discussed and synthesised, followed by some concluding remarks and implications for future research.

## 2 Degrowth – less is more.

‘Less is more’ – the title of Jason Hickel's (2022) book neatly captures the essence of Degrowth. While it seeks to overcome the capitalist growth imperative and reduce the resource and energy throughput of human societies, it aims to consolidate and even expand their quality of life. Degrowth is a diverse field of study originating from the discipline of ecological economics as well as various social movements and consists of several different streams<sup>1</sup>. The unifying theme is their critique of the concept of economic growth and its continuous pursuit in capitalist economies. It rests on the core assumption that an absolute ‘decoupling’ of GDP growth from resource and energy use is impossible. There is considerable empirical evidence for that claim (Haberl et al., 2020; Hickel & Kallis, 2020; Parrique et al., 2019; Vadén et al., 2020).

There are multiple lines of growth critique within the Degrowth movement: While some focus on ecological breakdown and planetary boundaries, others highlight growth's tendency to exacerbate class, race, or gender inequalities as well as the global North-South divide. This is complemented by cultural and anti-industrialist lines of growth critique (Schmelzer et al., 2022).

Hickel defines Degrowth as

‘a planned reduction of energy and resource throughput designed to bring the economy back into balance with the living world in a way that reduces inequality and improves human well-being.’

(2021, p. 1106)

Other definitions additionally highlight the democratic nature of this process, for example, Cattaneo et al. (2012) describe Degrowth as ‘a socially equitable and

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<sup>1</sup> Schmelzer & Vetter (2021) identify five streams of degrowth thought, with considerable overlap between them: approaches focused on (1) institutional change, (2) sufficiency, (3) commons and alternative economies, (4) feminism and (5) a critique of capitalism and globalisation (pp. 151-58).

democratic process of downscaling the economy and bringing it within ecological limits' (p. 515).

Understanding and overcoming the growth-dependencies of the current capitalist system is one the central topics in Degrowth research. According to Schmelzer & Vetter (2021), there are four major areas in which growth dependency can and must be challenged: 'material infrastructures and technical systems; societal institutions; mental infrastructures; and finally, the economic system as a whole' (p. 26).

## 2.1 Degrowth objectives and policies

In a joint comment in *Nature*, eight Degrowth researchers summarised the core objectives of practical Degrowth policies:

'Wealthy economies should abandon growth of [GDP] as a goal, scale down destructive and unnecessary forms of production to reduce energy and material use, and focus economic activity around securing human needs and well-being. ... Degrowth is a purposeful strategy to stabilize economies and achieve social and ecological goals, unlike recession, which is chaotic and socially destabilizing and occurs when growth-dependent economies fail to grow'.

(Hickel et al., 2022, pp. 400–401)

According to Banerjee et al. (2021, pp. 344–345), there are four key principles of Degrowth that can be found throughout the literature: *frugal abundance*, *conviviality*, *care*, and *open relocation*:

### **Frugal abundance**

In a Degrowth economy, one primary objective is to achieve collective sufficiency. This includes the equitable provision for everyone's basic (material) needs while also striving to increase people's subjective well-being through healthy social relationships, purposeful work, a sense of community, or other forms of immaterial wealth (Banerjee 2021, p. 344).

## **Conviviality**

Degrowth proponents usually have a critical though not hostile relationship with technology. Based on the works of Ivan Illich, many within the field propose a ‘convivial’ use of technology. The five basic principles of convivial technology are ‘connectedness, accessibility, adaptability, bio-interaction, and appropriateness’ (Schmelzer et al., 2022, p. 230). This stands in stark contrast to capitalism, where technological development is considered automatic and generally desirable. Technology functions as a means for generating profit and/or as a control mechanism for governments and corporations. From a degrowth perspective, technology and technological development should be a matter of democratic deliberation and focused on serving human needs and planetary health (Schmelzer et al., 2022).

## **Care**

Degrowth seeks to revalorize care work and move it from the sideline to the centre of the economy:

‘Social practices that promote daily wellbeing in families, friendships, neighborhoods, communities and nations are essential building blocks for constructing a viable post-growth world but are presently the most taken-for-granted and economically undervalued aspects of societies.’

(Banerjee et al., 2021, p. 344)

## **Open relocation**

Degrowth seeks to establish an economy where most needs can be provided for through local production and short value-chains (Banerjee et al. 2021, p. 344). The aim is to substantially reduce global trade in consumption goods, but without embracing isolationism or extreme protectionism, hence the term ‘open’. This approach of ‘voluntary simplicity’ is particularly popular within the sufficiency current of the Degrowth movement (Schmelzer & Vetter, 2021, p. 154).

There are numerous concrete policy proposals to achieve these objectives. Fitzpatrick et al. identified ‘a grand total of 530 proposals (50 goals, 100 objectives, 380 instruments)’ (2022, p. 1) in their systematic review of the Degrowth literature. The most commonly cited ones include work-time reductions, job guarantees with a living wage, maximum income caps, deliberative forums, not-for-profit cooperatives,

declining caps on resource use and emissions, reclaiming the commons, ecovillages, and housing cooperatives (p. 6). There is also great support for either a universal basic income or universal basic services (Gough, 2021). Hickel et al. add the following policies: ‘Reduce less-necessary production ... Improve public services ... Introduce a green jobs guarantee ... Reduce working time ... Enable sustainable development’ (2022, p. 401).

## 2.2 Democratisation as a prerequisite of degrowth

Degrowth envisions a radical transformation of the current socio-economic system. It requires a redistribution of wealth and privilege, the re-organisation of work and welfare models, and limits on excessive resource and energy use. Such a transformation is unlikely to be achieved through the current political systems in industrialized nations. In their current state, electoral democracies reward short-term thinking and penalize politicians who make unpopular or controversial decisions. In addition, vested interest groups (like the fossil fuel industry) can easily exploit the complexity and the trade-offs inherent to a social and ecological transformation and block transformative policies through lobbyism and the manipulation of public opinion (Duvic-Paoli, 2022).

One could imagine such measures to be implemented in an authoritarian way, or through some kind of technocratic ‘eco-dictatorship’.<sup>2</sup> This, however, is not what Degrowth envisions. As electoral politics are unable to deliver and authoritarianism is rejected for ethical reasons, the only possible way to achieve the Degrowth agenda is through broad democratic deliberation. Democratisation is thus essential for the Degrowth transformation.

Whether Degrowth should focus on reformist or confrontational strategies is, unsurprisingly, intensely debated among its proponents (Asara et al., 2013; Cattaneo et al., 2012). Many propose the simultaneous pursuit of three strategies, based on Erik Olin Wright’s writings on social transformation: *‘interstitial’* (‘nowtopias’) ... *‘sympiotic’* (‘non-reformist reforms’) ... *‘ruptural’* (‘counter-hegemony’) strategies’ (Schmelzer et al., 2022, pp. 255–275; see also: Singer, 2023). On the other hand, there is

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<sup>2</sup> Romano (2012) discusses this issue in great detail.



almost unanimous support within the Degrowth community for economic democracy and deliberative democracy. Citizens' assemblies, workers' councils, and cooperatives are typical suggestions discussed in the literature to expand or replace existing democratic decision-making (Cattaneo et al., 2012; Ott, 2012).

### 2.3 Coordination of a democratic Degrowth economy

Citizens' assemblies and other forms of deliberative democracy have shown great potential for de-polarising highly contested political topics. Assemblies charged with debating solutions to the climate crisis routinely propose progressive policies that are supported by a broad majority of the participants (Duvic-Paoli, 2022). However, these forms of democratic deliberation require much time and effort, rendering them impracticable for day-to-day decision-making. Thus, they can be useful tools to establish general guidelines for the Degrowth transformation but not serve as its primary economic coordination mechanism.

Small-scale, re-localized production, and cooperatives are generally championed by Degrowth advocates. And in some areas, like communal farming or food cooperatives, they show great potential (Brossmann & Islar, 2020). However, as Joutsenvirta argues

‘[t]he transformative power of proactive bottom-up initiatives ... should not be exaggerated nor left without good use. Radical actors are embedded in the existing institutional structures that tend to privilege certain types of social organizing and individual behaviour.’

(Joutsenvirta, 2016, p. 30)

Thus, the transformation and organisation of the entire economic sphere by local cooperatives and deliberative democracy alone is highly unlikely.

How, then, could a Degrowth economy produce sophisticated medical equipment, pharmaceuticals, wind, and solar modules for a decentralized energy grid, trains, electric buses for sustainable mobility, and digital communication systems? It is unlikely that the coordination of the complex industrial value chains required for their production and distribution could be achieved solely through deliberative forums, councils, and small-scale production units. Unless one wants to return to

rather primitive, anti-technological lifestyles – like some factions within the Degrowth community do suggest – an effective model for large-scale, democratic economic coordination must be found.

Oftentimes, the Degrowth transformation is described as a planned or coordinated process. How exactly this ‘planning’ might look like, however, remains unclear. Although there has been a vital debate on democratic economic planning in (eco)socialist circles in recent decades, the Degrowth debate so far has largely overlooked this. Schmelzer et al. conclude that

‘there is strikingly little explicit engagement with or research into what exactly ‘planning for degrowth’ could look like, given the fact that degrowth favours decentralized structures over hierarchical bureaucratic centralized ones.’

(2022, p. 295)

Only very recently, Kohei Saito (2023) introduced the issue of democratic planning for Degrowth to a wider public with his concept of Degrowth Communism, while the July-August 2023 issue of Monthly Review discussed the topic in a series of articles.

In the following sections, I aim to approach the largely unanswered question of how democratic planning could contribute to the Degrowth transformation. Due to the diversity of the field, I cannot consider all the nuances of various Degrowth currents when evaluating its compatibility with different planning models. Therefore, I will concentrate on the following broad dimensions, derived from the Degrowth objectives outlined above:

- **Material dimension**

Downscaling of resource and energy throughput, phasing out highly destructive sectors, reducing global trade volumes.

- **Redefining ‘the economy’**

Focusing on human needs and well-being, collective sufficiency, placing care and reproductive work at the centre of the economy.

- **Technology**

Conviviality and purposeful technological development.

- **Democratisation**

Organising economic affairs in a participatory and socially equitable way.

## 3 Economic planning, cybernetics & artificial intelligence

### 3.1 Economic planning & economic calculation

#### 3.1.1 The Socialist Calculation Debate

The Economic Calculation Debate or Socialist Calculation Debate was a controversy about the feasibility of a socialist planned economy, starting in the early 20<sup>th</sup> century. Some of its main contributors were Otto Neurath, Oskar Lange, and Abba Lerner on the socialist side, and Ludwig von Mises and Friedrich A. Hayek on the side of Austrian economics (Phillips & Rozworski, 2019).

Socialists argued that it was possible, and more efficient, to plan a national economy instead of letting markets decide what to produce. There was considerable disagreement within the socialist camp about the type of economic calculation performed in a planned economy. Several mechanisms were suggested: calculation in kind, labour-time calculation, or complex statistical equations that would be solved by an economic council (Phillips & Rozworski, 2019; Saros, 2014). Oskar Lange later developed a model of market socialism that was based on neoclassical modelling. Factory managers would set prices for their products in a trial-and-error-method while prices for inputs would be determined by a planning board (Morozov, 2019). He intended to create a system that would reap the benefits of both markets and planning.

Mises, Hayek, and other economists of the Austrian school on the other side argued that without the price mechanism, private property of the means of production, and competition, economic calculation could not work (Morozov, 2019).

#### **The computation problem**

Mises argued that gathering and processing all relevant economic information and then planning accordingly would go beyond what humans or machines can do (Phillips & Rozworski, 2019, p. 27). Even if gathering knowledge about supply and demand wasn't a problem, the argument goes, that the sheer amount of data would be impossible to manage. Gosplan, the Soviet Union's planning agency, faced this problem when trying to compute the amount of raw and intermediate goods needed for producing consumer goods. According to Cockshott & Cottrell,

‘[w]orking backwards from a target list of final outputs to the required list of gross outputs, consistently and in detail, was quite beyond the capacity of Gosplan ... Often, instead, the planners started out from targets that were themselves set in gross terms: so many tons of steel by 1930, so many tons of coal by 1935, and so on’

(1993, p. 78)

This however, is the least of all problems of economic calculation: Boettke & Candela stress the importance of ‘context-specific knowledge’ (2023, p. 51) in the argument of Mises and Hayek: Without markets and competition, they argue, detailed knowledge about consumer demands, production capacities, etc. can simply not emerge. The problem with economic planning is hence not primarily one of computing power but one of lack of knowledge.

### **Prices and knowledge**

This core argument against planning concerns the knowledge production itself. Mises and Hayek argued that no one person or institution can acquire the knowledge that is produced in the countless interactions on the market and communicated via a single piece of information: the price or monetary value. A central planning agency would have to know all information relevant to all sectors of the economy. Entrepreneurs in a market economy, on the other hand, only need to possess the information about the goods they are buying and selling themselves and can ignore all other information. The price mechanism condenses all relevant information about supply and demand into a single number that individuals and corporations can act upon (Saros, 2014).

Still, prices have significant downsides. They also conceal important information. In contrast to neoclassical assumptions, consumers do not usually possess all the relevant information to make a rational decision. Sellers can withhold information about the qualities of their product if they think that they can sell it at a higher price by doing so (Morozov, 2019). Market prices also usually don’t account for environmental externalities like biodiversity loss and climate change.

As Morozov argues, ‘[s]uch an elegant and information-light arrangement as the price mechanism can only work because much of the actual complexity of competition is handled and reduced elsewhere in the economic system’ (2019, section 2, para. 8). This is because the profit motive and other norms ingrained into capitalism greatly reduce the set of actions market participants can expect from one another. Additionally, there

are other ways used to convey information ‘which shape the dynamics of competition *before* market exchange takes place’ (Morozov, 2019, section 2, para. 9). Any non-capitalist system would thus require new rules and customs to guide expectations and effectively coordinate economic activity.

The argument about prices and knowledge is generally supported even by some proponents of economic planning. While they do accept that no central planning agency could acquire the relevant knowledge about the economy, they argue that a decentralized and participatory planning system would solve this problem (Albert & Hahnel, 1991; Cockshott & Cottrell, 1993; Saros, 2014).

### **Competition as a discovery process**

Another argument brought forth by Hayek is that only competition in markets can enable discovery and innovation. In this view, competition enables ‘consumers [to] unearth new tastes and producers [to] develop new techniques of production’ (Morozov, 2019, section 3, para. 7). Central planners, on the other hand, could rarely discover so-called unknown unknowns.

Like the other critiques mentioned above, this argument suffers from the assumption that the only alternative to a market system would be *central* planning. Even the more sophisticated critiques – like the one by Hayek – do not seriously engage with the possibility of decentralized planning (Morozov, 2019; Saros, 2014). Considering the available information technology at their time, they were very likely correct in saying that centralized planning was practically impossible.

But, as modern information technologies become ever more powerful, this argument might have lost its significance. Cottrell & Cockshott argue that *‘the material conditions (computational technology) for effective socialist planning of a complex peacetime economy were not realized before, say, the mid-1980s’* (1993, p.31, cursive in original). What might have been a bold claim thirty years ago now seems much more plausible given the current developments in artificial intelligence and cloud computing.

### 3.1.2 Economic calculation with artificial intelligence?

Artificial intelligence (AI) can be defined as

‘a system’s ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation.’

(ESCP France as cited in: Haenlein & Kaplan, 2019, p. 1)

While the concept was established as early as the 1940s, its widespread use is a relatively recent phenomenon. Modern AI concepts, such as artificial neural networks and Deep Learning, which are widely used today, only became practically applicable during the 2010s. AI applications include translation and chatbots, planning and optimisation tools and facial or image recognition, among many others (Haenlein & Kaplan, 2019). AI tools specialized in providing solutions to complex optimisation problems are of particular interest in the context of the calculation debate and are already utilized by companies such as Amazon (Phillips & Rozworski, 2019; see also section 3.4.2).

#### **The computation problem**

This problem is arguably the simplest to address. Modern computers, such as those utilized for climate modelling and weather forecasting, possess processing power unimaginable to the participants of the original Calculation Debate (Phillips & Rozworski, 2019). Furthermore, as described in section 3.4.2, corporations already employ computers and AI to manage vast data sets for internal planning. In addition to the pure computational power of modern technology, there are methods to reduce the complexity of datasets without compromising the quality of results (see section 3.2 on cybernetics).

#### **The knowledge problem**

In an economy with innumerable customers and producers, each with diverse and often unclear preferences, any model for economic coordination must reduce this complexity to manageable levels. According to Hayek, this can only be achieved through competition and the price mechanism. However, as Morozov (2019) argues, digital feedback infrastructures can also play a crucial role in achieving this goal. He particularly emphasizes the significance of cybernetics as an essential concept, which

I will examine more closely in section 3.2. Additionally, he references the predictive capacities of Big Data utilized by companies like Amazon to anticipate consumer demand for specific products. Srnicek (2020) describes in detail how the giants of digital capitalism mastered the gathering of information and made it their core business model. To address the knowledge problem in a democratically planned economy, it is essential to carefully design a public digital platform that enables continuous user feedback and dynamic adjustments to the plan while providing as much privacy as possible.

### **Discovery without market competition**

Concerning discovery and innovation, Morozov points out that '[d]igital 'feedback infrastructure' could be used to flag social problems and even facilitate deliberation around them, by presenting different conceptual approaches to the issues involved' (2019, section 3, para. 8). He suggests the creation of digital infrastructures that can 'match 'problem-finders'...with 'problem-solvers'' (ibid.), based on the assumption that people are not exclusively motivated by profit but also by altruism, solidarity or the intrinsic motivation to solve a problem.

In addition, competition can also hinder innovation. This could occur when firms choose to withhold information rather than share it, resulting in inefficient dual structures (Morozov, 2019). Or because desirable technologies like certain medical drugs are not further developed due to their inability to generate profits (Phillips & Rozworski, 2019).

## **3.2 Cybernetics**

### **3.2.1 Norbert Wiener and the origins of cybernetics**

Cybernetics emerged during the Second World War as a science of 'control and communication in the animal and the machine' (Wiener 1948). It is an interdisciplinary approach studying interactions within mechanical, biological, or social systems. Feedback mechanisms play a central role in cybernetic thinking and replaced the hitherto dominant notion of linear cause-and-effect relationships (Medina, 2014, p. 33). The concept was popularized by US mathematician Norbert Wiener after designing an anti-aircraft gun for the British army in the Second World War that used feedback mechanisms for more accurate aiming. After the war,

Wiener's cybernetic approach was strongly promoted in the United States, often to gain military and economic advantages in the Cold War (Gardiner, 2022). In the following decades, aspects of the concept were also adopted by planners in the Soviet Union and other non-Western countries (Medina, 2014; West, 2020). The development of modern information technologies has sparked renewed interest in cybernetics in recent decades, as they enable easier and more extensive application of the concept (Dyer-Witheford, 2013).

### 3.2.2 Stafford Beer's management cybernetics

The UK variant of cybernetics, sometimes referred to as 'second-order cybernetics', had fewer ties to military research and put a stronger 'emphasis on decentralisation, spontaneity, and non-representationalism' (Gardiner, 2022, p. 5) than its US counterpart. An outstanding role in the development of the field can be attributed to British cybernetician Stafford Beer who developed efficient management practices for Western corporations but also designed project CyberSyn, the decentralized, economic planning system for Allende's socialist Chile (see section 3.2.2). His definition of cybernetics as a 'science of effective organization' (Medina, 2014, p. 32) put less emphasis on hierarchical control and instead promoted self-regulating and adaptable systems akin to the human brain and nervous system. In the following, I will provide a summary of the central concepts for Beer's management cybernetics as they were later adopted in economic planning.

#### **Adaptive control, variety attenuation and regulative variety**

In contrast to the conventional understanding of control, Beer 'defined control as self-regulation, or the ability of a system to adapt to internal and external changes and survive' (Medina, 2014, p. 37). He was particularly interested in 'exceedingly complex systems' (Beer, 1967, p. 30) that cannot be understood in total – like the human brain, a company, or an entire economy. Studying and regulating these kinds of systems requires to deliberately 'black-box' some components of the system, looking only at their input and output, and to think in a probabilistic instead of a deterministic way. As the behaviour of any subsystem of an exceedingly complex system (e.g. a factory within a national economy) can exhibit a great variety of different behaviours, anyone seeking to control the system also has to be highly flexible. The top-down way of controlling is doomed to fail when applied to exceedingly complex systems (Medina, 2014, pp. 37–39).



This concept of cybernetic control has been suggested by various authors as a possible solution to the calculation problem in economic planning (Cockshott & Cottrell, 1993; Saros, 2014), including scientists during the later decades of the Soviet Union (see section 3.3.1) (West, 2020).

Variety attenuation refers to the creation of ‘rules, standards, ethical prohibitions’ (Morozov, 2019, section 3, para. 15) and other means to reduce the potential variety of the system’s components.

Amplifying regulative variety, on the other hand, aims to ‘detect emerging complexity early-on ... and, instead of standardizing the responses of individual components, give them as much autonomy and power in overcoming ... complexity as possible’ (Morozov, 2019, section 3, para. 15).

When applied to a planned economy, Beer’s variant of cybernetics implies a different approach than imagined by most thinkers in the original socialist calculation debate. Instead of trying to understand and control (in the conventional sense) every little detail of the economy, complexity should be reduced by variety attenuation, amplifying regulative variety and adaptive control. The first comprehensive application of these concepts to help plan an entire economy was Project CyberSyn in Chile, which I discuss in section 3.3.2 Project CyberSyn

Within the political left, cybernetics has been a controversial topic throughout its history. Some point towards the risk of the concept being used to de-politicize and de-humanize governance and economics. This critique of cybernetics as a tool for ‘rational’ control is particularly prevalent in anarchist circles (Schaupp, 2019). Others highlight its emancipatory potential arguing that the ‘cybernetic principles can be effectively detached from capitalistic imperatives and redirected towards postcapitalist, universally liberatory goals’ (Gardiner, 2022, p. 4).

### 3.3 Planning in socialist economies

#### 3.3.1 Central planning in the Soviet Union

Economic planning in the Soviet Union took many forms during the nearly seven decades of its existence. Here, I will not provide a detailed historical account, but

instead highlight some of the most significant challenges faced by the planning system and its administrators.

Although the Soviet economy achieved remarkable early successes in terms of productivity gains and rapid industrialisation, (Allen, 2001), it was also plagued by significant flaws.<sup>3</sup> These shortcomings included ‘chronically incoherent plans, recurrent shortages, and surpluses, lack of responsiveness to consumer demand’ (Cottrell & Cockshott, 1993, p. 31), resource depletion, and energy inefficiency (Allen, 2001), and poor transmission of information (Phillips & Rozworski, 2019).

From a Degrowth perspective, two aspects of the Soviet Union's planned economy were particularly problematic. Firstly, akin to its capitalist Western counterparts, it prioritized productivism and economic growth with little consideration for planetary boundaries. And secondly, it was organized in an authoritarian and non-democratic fashion.

### **Productivism and resource exploitation**

One of the reasons for economic decline after the 1970s was the sharply rising cost and increased difficulty of exploiting natural resources like oil, coal, and metals. The USSR turned to developing Siberia as the easily exploitable deposits elsewhere were largely depleted. The fossil fuel sector devoured huge investment sums and labour power while contributing less and less to overall productivity and export revenue. Energy efficiency in the USSR was very low, consuming more than twice as much energy per unit of GDP than the average OECD country in the 1980s. Attempts to reduce energy consumption were little effective. One of the reasons was a lack of metering technology for oil and gas use and thus, a lack of crucial information about the energy use of individual factories and households (Allen, 2001, pp. 876–878).

Apart from excessive energy use, the pursuit of production targets at all costs regularly lead to large-scale environmental disasters. One prominent example is the overexploitation and drying up of the Aral Sea, resulting in a near-complete collapse of its fish stocks and massive changes to the surrounding region's climate. Further problems were the contamination and erosion of arable land, unsustainable forest

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<sup>3</sup> As this paper is specifically concerned with economic planning, I will not discuss the wider political climate in the USSR. It should be noted, however, that these early economic successes were accompanied by mass displacements, forced labour and the violent suppression of opposition, especially during the Stalinist era.

logging, and pollution from fossil fuel and mineral extraction (Gare, 2002). In 1983, reacting to the Club of Rome's *Limits to Growth* report, Soviet cybernetician Olga Burmatova suggested that cybernetic planning could solve ecological problems by integrating environmental variables into planning models (West, 2020). Her ideas, however, were never implemented.

### **Authoritarianism and information deficiencies**

Phillips & Rozworski (2019) argue that the Soviet Union's authoritarian and centralized structure was a key reason for widespread misreporting and the following lack of sound economic data. Managers and bureaucrats on all levels regularly reported embellished data out of fear of punishment and because of bad incentives. They conclude that, therefore, a successful planning system must be democratic and decentralized, because 'authoritarianism drives degradation of information, which undermines planning' (p. 150). They further argue that '[w]ithout democratic input from consumers and producers, the daily experience of the millions of living participants in the economy, planning cannot work. Democracy...is essential to the process' (p. 213). Cockshott & Cottrell (1993, p. 111) and Hahnel (2021) also emphasize the need for incentives to provide accurate information within a planning system.

There have been attempts to decentralise planning in Soviet economic history. During the Khrushchev period from 1953 to 1964, cybernetics were officially adopted as a tool for economic planning, among other reforms. This included efforts to rapidly develop frontier regions in Siberia by using dynamic and decentralized planning methods. This innovative and, to some degree, participatory approach showed promising initial results. However, many of the ambitious cybernetic projects, like OGAS<sup>4</sup>, were never (fully) realized. Reasons were insufficient computing power and high development costs but also reluctance in parts of the Soviet bureaucracy, especially after Khrushchev's ousting (Dyer-Witheford, 2013; Gardiner, 2022; West, 2020). This was a recurring problem: Despite the development of groundbreaking concepts such as input-output analysis or linear programming in the USSR, their full potential could never be realized. In many cases, this was due to resistance from conservative government departments that feared a loss of significance. Instead, many of these concepts were later applied in Western businesses with great success after they have

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<sup>4</sup> A nation-wide, multi-layered computer network conceived by Victor Glushkov in the 1960s that 'would have introduced a high level of self-governance, bureaucratic transparency, and even something we might consider a precursor to participatory governance and digital citizenship' (West 2020, 38)

been introduced by Soviet emigrants (Dyer-Witheford, 2013; Phillips & Rozworski, 2019).

In the following decades up until its dissolution, the USSR fell significantly behind the West in computer development, further complicating efforts for cybernetic automatization. According to Cottrell & Cockshott (1993, p. 31), the necessary computational technology for complex planning operations was not available before the mid-1980s. The notion that insufficient computing power was one of the reasons for the Soviet Union's economic decline is shared by Phillips & Rozworski (2019) and Saros (2014).

### 3.3.2 Project CyberSyn – Chile's short-lived democratic planning experiment

During the brief presidency of Salvador Allende 1970-73, there was an attempt to construct a participatory, cybernetic planning system in Chile called project *CyberSyn* or *proyecto Synco*. In contrast to the Soviet Union, Allende's socialist approach included civil liberties, the rule of law, and respect for the existing Chilean constitution (Medina, 2014). A centralized command economy was thus not an option to control Chile's industrial production.

Nationalising its major industries was a challenge for the Chilean government and its development corporation CORFO. Therefore, Stafford Beer was hired to develop a cybernetic system that would allow for coordination and communication between factories, industry sectors, and the central government. It comprised several hundred telex machines in the factories which would send information to each other and to the central government in Santiago where the data was collected by a single IBM mainframe computer and fed into a simple economic forecasting model. In a control room nearby, government officials could access up-to-date economic data, debate, and intervene in case of a severe problem (Medina, 2014).

Compared to the Soviet Union, the system was characterized by less centralisation and more efficient utilisation of data, transmitting only the most relevant production indices to the central government. Extensive autonomy was granted to lower levels of the system in meeting their production targets. Higher levels only got involved if serious problems arose, and when the factory or regional managers couldn't resolve the issue within a specific timeframe. The objective was to attain the highest possible degree of self-regulation while maintaining a comprehensive overview of industrial

production and the ability to steer it in specific directions – adaptive control as imagined by Beer. The system could also prove its usefulness when it helped to mitigate the effects of two national truck drivers' strikes. The government used the information network to effectively arrange the transport of essential goods within the country (Medina, 2014).

However, CyberSyn's development could never be completed. The project was terminated after the coup in September 1973 that resulted in Allende's death and the installation of the military dictatorship under Pinochet. Thus, the true potential of the Chilean way of cybernetic socialist planning remains speculative. Medina (2014) also points out certain negative aspects of the project, including its focus on male workers and the consequent perpetuation of gender inequality. Still, given the short development time of just two years, restricted technological resources, and fierce domestic and foreign opposition, it was a remarkable achievement. Beer and many of those involved in project CyberSyn continued to apply and further develop the concepts of cybernetic management in different contexts (Medina, 2014).

### 3.4 Planning under capitalism

Economic planning is not exclusive to socialism. In this section, I will briefly discuss two quite distinct forms of planning under capitalism: the British War Economy 1939-45 and the internal planning operations of modern mega-corporations like Amazon and Walmart.

#### 3.4.1 British War Economy – a planned economy with private capital?

The British economy during the Second World War is a curious case. Although private ownership of capital and private profits remained largely intact, the government assumed the role of a central planner, directly allocating labour and resources. For essential goods, the price mechanism gave way to the statistical assessment of material stocks and flows (Howlett, 1993). While the primary objective was the military and economic mobilisation necessary to win the war, the planning policy also had significant impacts on domestic social relations. Redistribution through progressive taxation, subsidisation, and rationing of food and the creation of various public services led to a striking reduction in inequality and significant improvements to the living conditions of the working class. Although it was still a time of hardship,

the government's policy generally enjoyed high popularity and contributed to the post-war consensus of welfare in Britain (Herrmann, 2022; Phillips & Rozworski, 2019).

Important decisions were made by the War Cabinet consisting of the Prime Minister and high-ranking cabinet members. Concrete planning and resource allocation was undertaken by various ministerial committees and their respective administrations (Howlett, 1993). Such top-down modes of governance with a high concentration of power are not participatory approaches consistent with Degrowth's vision for economic democracy.

Still, historian and journalist Ulrike Herrmann argues that a model resembling the British war economy is the most feasible for the immediate transformation of current capitalist economies towards Degrowth (Herrmann, 2022). The downscaling of particularly harmful industries and limits on excessive resource consumption, she argues, are most likely to be achieved by a planning state, while policies aiming at a more egalitarian distribution of income and wealth are essential for sufficient public support.

### 3.4.2 Walmart, Amazon & Co. – planning in capitalist corporations

To some extent, planning has always been a part of the operations of capitalist enterprises. They routinely plan how much to produce, determine the necessary inputs for production, target specific customer groups, and plan for business expansion. However, if this planning is limited to a company's internal operations, this does not truly qualify as 'economic planning' and is rather referred to simply as management. But in recent decades, some of the largest corporations have taken planning a step further. Global giants like Walmart or Amazon control vast networks comprising producers, distributors, and retailers, offering an extensive range of products (Phillips & Rozworski, 2019).

Since 1995, Walmart has developed an approach they call 'Collaborative Planning, Forecasting and Replenishment (CPFR)' (8th & Walton, 2022, para. 4). In a 9-step process, a comprehensive business plan is created using sales forecasts based on customer data and feedback from suppliers. This is made possible by a common digital platform and exact data about stocks and sales within Walmart and all its partners. Dyer-Witthford describes the system as follows:

‘Barcode scanners and point of sale computer systems identify each item sold, and store this information. Satellite telecommunications link directly from stores to the central computer system, and from that system to the computers of suppliers, to allow automatic reordering.’

(2013, p. 9)

The partially automated integration of formally independent enterprises into the business plan of a single corporation, which sells hundreds of millions of different products, resembles in scale and complexity a planned national economy. Prices and market mechanisms have minimal to no significance within these networks. Amazon, for instance, possesses extensive knowledge about its customers' wants and needs. However, this information is not acquired through price signals; rather, it is directly gathered by tracking customers' behaviour on their website. By filtering and analysing these vast quantities of data, the company can predict rather precisely the products it requires, in what quantity, when, and where (Morozov, 2019; Phillips & Rozworski, 2019).

Many large industrial corporations use synchronized digital networks of trackers and sensors in their factories to gain access to real-time production data, enabling them to increase the speed and efficiency of production. This approach is commonly referred to as the ‘Internet of Things’ or ‘Industry 4.0’ (Srnicek, 2020). For example, the Volkswagen Group has recently introduced its ‘Industrial Cloud’ – a digital platform connecting all 120 VW factories, with plans to expand its scope to include suppliers as well. Through the real-time collection and sharing of production data, errors and inefficiencies can be swiftly detected and handled (Volkswagen, 2021). As the Industrial Cloud is developed within a capitalist corporation, it is little surprising that its stated objectives are increased efficiency, productivity, and growth. Its design resembles Beer’s concept of management cybernetics in many ways, with great autonomy and flexibility given to the individual production sites:

The exchange follows the app store principle: every site can use the Industrial Cloud to source the software applications that are useful on site. The plants can also use standardised tools to develop site-specific solutions themselves and then make them available to other plants via the Industrial Cloud.

(Volkswagen, 2021, para. 5)

These developments have not gone unnoticed by socialists and those concerned with the feasibility of economic planning. In their current form, the systems utilized by companies like Amazon are designed to facilitate capitalist accumulation, while being non-participatory and lacking transparency. However, the potential of these systems to finally enable democratic economic planning has inspired several authors to devise planning models that make use of modern information technology.

## 4 Proposals for democratic economic planning

The details of each of the three models fill one or even several books, so I can present them here only in a very condensed form. I will focus on the following two aspects:

- Overview of the planning system
- Mode of participation in planning and democratic structure

I will then examine the planning models from a Degrowth perspective, looking for potential intersecting objectives or conflicts.

### 4.1 Cockshott & Cottrell – New Socialism (Scottish Model)

In their book *Towards a New Socialism*, computer scientists Paul Cockshott & Allin Cottrell imagine a socialism based on ‘radical democracy and efficient planning’ (Cockshott & Cottrell, 1993, p. 7). They criticize the Soviet planning model as inefficient and undemocratic and suggest a democratic planning model using modern computer technology and cybernetic principles. Their proposal is sometimes called the ‘Scottish Model’, referring to the authors’ origin. (Hahnel, 2021).

#### 4.1.1 Planning system

Strongly rooted in Marxist theory, they propose a moneyless economy with labour-time as its unit of account. Workers receive tokens for their performed labour time. While access to basic provisions (e.g., education, health, childcare) will be directly attributed by plan, other things can be bought with labour tokens on a kind of market (Cockshott & Cottrell, 1993, p. 69). The authors propose that every able-bodied individual is required to work a minimum number of hours in exchange for the basic provisions. People can then choose to work longer hours to gain more labour tokens



for acquiring consumer goods (p. 99). These products are priced according to the total (direct and indirect) labour time required to produce them. This price, however, can be adjusted to reflect consumer demand which in turn would prompt planners to produce more or less of the product in the future (p. 103). The objective is to sell all goods at market-clearing prices, with no under- or over-production occurring.

Planning takes place on three levels: macroeconomic, strategic, and detailed production planning, with specified decision-making structures and algorithmic procedures devised for each level. Instead of calculating the perfect or optimal resource allocation, computers would only need to calculate a sufficiently close approximation, significantly reducing required processing power and time.

Aspects of daily household and care work can be done by communes consisting of a few hundred people each. Examples are communal child and elderly care or meal preparations. These communes are officially incentivized, but participation is not mandatory (pp. 147-50).

#### 4.1.2 Democracy & participation

Stating that ‘all capitalist states are plutocratic oligarchies’ (Cockshott & Cottrell, 1993, p. 158), the authors want to put an end to parliamentary democracy and seek to establish a model resembling ancient Greek democracy in the *polis*. Major decisions (like taxation levels or general budget guidelines) would be made via electronic public referendum. Instead of having professional politicians, day-to-day decisions would be taken by citizen councils chosen randomly by lot. Each institution (e.g., water or electricity company, railways) would be supervised by such councils. The authors argue that this would substantially increase peoples’ sense of community and responsibility. Concrete planning, however, would mostly be done by circles of technical and economic expert juries (pp. 164–165).

Overall, their governance model would be a combination of technocratic planning and direct democracy through citizens’ councils and public votes. The state would still exist, though in a radically altered form: ‘a state without a head of state, without the hierarchy that marks a state based on class exploitation’ (p. 167).

#### 4.1.3 Discussion

New Socialism is a comprehensive model encompassing foreign trade, reward and sanction mechanisms for enterprises, the algorithmic functions required for the

proposed resource allocation, labour tokens, consumer credits, etc. However, the model adopts a rather technocratic approach, where the planning process is primarily controlled by experts and algorithms with no direct participation of ordinary people. According to Hahnel (2021), the proposal ‘is simply a highly democratic version of central planning and ... does not allow workers to engage in meaningful self-management’ (p. 314).

In addition, the authors do not specify how the transition from the status quo to their desired configuration will be realized. Their writing seems to imply some form of violent revolution taking place. This contrasts with the majority of Degrowth literature, which typically seeks peaceful transformation paths (while acknowledging that they will not be devoid of conflict) (Schmelzer et al., 2022).

## 4.2 Albert & Hahnel – Participatory Economy (Parecon)

The Participatory Economy is a decentralized planning approach rooted in principles of self-determination and self-governance. It has mostly been developed by Michael Albert & Robin Hahnel in a series of books and articles. Starting in the early 1990s, they have since continuously expanded and adjusted the concept.

### 4.2.1 Planning system

There is no private property in the means of production, or what Hahnel (2021) calls the ‘*productive commons for modern times*’ (p. 88) – comprising the ‘*natural commons ... produced commons* [and] *information commons*’ (ibid.). At the heart of the Parecon system are worker councils (=enterprises), neighbourhood consumer councils, and their respective federations on different levels (city, region, state...). They or their elected delegates come together in annual planning meetings where they are supported by the Iteration Facilitation Board (IFB). The IFB has no decision-making authority but assumes a coordinating role in the planning process. With the help of powerful computers, it performs the complex calculations required for converging the proposals and provides the participants with detailed information. The creation of the annual plan works as follows:

The IFB proposes a set of indicative prices for every type of consumer good, resource, type of labour, etc. Worker councils then submit production proposals while consumer

council federations submit aggregated consumption proposals<sup>5</sup>. On the consumption side, public consumption demand is handled first so that private consumption is only necessary for needs not already satisfied through public goods (p. 134). As the first result is very unlikely to be balanced out, the IFB then proposes a new, adapted set of prices, followed by new proposals from the workers' and consumers' councils. This process is repeated several times until a feasible plan emerges (Hahnel, 2021, pp. 93–96). Pollutants are integrated into the planning procedure and priced via a 'pollution demand revealing mechanism' (p. 162) to reduce pollution 'to reasonably "efficient" levels' (ibid.). For the sake of practicality, there usually is no voting on proposals. If the social benefit/social cost ratio of a worker council's proposal is 1 or higher, it is accepted. If the ratio is below 1, it is not accepted. There can be exceptions, e. g. for infant industries that are not yet socially beneficial.

In addition to the annual plan exist four other, longer-term plans: educational and environmental planning, international economic planning, and infrastructure planning (p. 217). They are mostly carried out by different configurations of the worker and consumer council federations, specialized ministries in a coordinating role similar to the IFBs, and public referenda on fundamental issues. To provide future generations with equal economic opportunities, long-term planning includes a 'generational equity constraint' (p. 226). This would restrict the growth of aggregate consumption from one year to the next by a democratically agreed percentage.

Work within the system is organized in 'balanced job complexes.' This means that each member of a workers' council is expected to perform both desirable and undesirable, empowering and unempowering tasks. Compensation is determined based on an individual's effort and the desirability of their work. In general, everyone is obliged to contribute a minimum amount of work, with exceptions made for those unable to work for various reasons (pp. 89, 91). Some basic needs are covered by free access to services like healthcare and education. Money is replaced with a non-transferrable currency which serves as a unit of account. There is no private currency creation (Participatory Economy Project, n.d.).

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<sup>5</sup> They consist of the consumption proposals made by individual households, each of which is automatically accepted by the federation if proposed consumption does not exceed a household's work compensation and allowances – ensuring practicality and privacy.

#### 4.2.2 Democracy & participation

The fundamental principle of Parecon is that people, organized into workers' and consumers' councils, have a voice in all matters that impact them to the extent to which they are affected by those matters. The concrete mode of decision-making within these councils is subject to their own deliberation. In contrast to Cockshott & Cottrell's proposal, the planning process itself is participatory and only mediated by the IFB. While Hahnel (2021) explains the responsibilities of certain ministries (e.g. economy, education, environment, external affairs) in Parecon's planning processes, the wider political system that would support it is not further elaborated.

#### 4.2.3 Discussion

Parecon stands out as one of the few comprehensive attempts to envision an alternative to capitalism. It provides enough detail to make it appear concrete and feasible while remaining open-ended and flexible, allowing individuals within the system to adapt it to their preferences. Over the last 30 years, Parecon has been revised and expanded several times, covering numerous policy areas that cannot all be discussed here in detail. Schmelzer et al. (2022) also mentioned the model as a potential addition to Degrowth. Its stated objectives '*economic democracy ... economic justice ... solidarity ... efficiency ... variety ... environmentally sustainable [economy]*' (Hahnel, 2021, p. 11) match well with Degrowth's principles.

Despite its great potential, there are certain objections to Parecon. One concern revolves around the concept of the annual plan, which appears quite restrictive. Not everyone may be able or willing to plan their consumption one year in advance. It's difficult for individuals to predict their wants and needs with such foresight. On the other hand, as Hahnel (2021) clarifies, people would not have to predict that they will want 'size 6 purple women's high-heeled shoes with a yellow toe' (p. 166) but rather that they will want a new pair of shoes this year. Shoe producers then decide which particular shoes they will produce, based on past and present consumption patterns. Just like producers in a market economy, they will make 'an educated guess' (p. 165) about consumer demand which can be refined and adapted continuously – not only during annual planning meetings.

Another issue is the objective measurement of work effort and desirability associated with specific jobs, as these judgements are inherently subjective, creating a potential for disputes and distrust among workers. Moreover, the egalitarian rationale behind

balanced job complexes is understandable, but not everyone possesses equal abilities to perform all kinds of work, leading to potential efficiency losses when highly trained or specialized workers are required to perform ‘simple’ tasks. However, as the balancing of jobs is organized by the worker councils themselves, it can be adapted to strike a compromise between egalitarianism and efficiency.

The transition from the current system to Parecon is not sketched out, but Hahnel thinks that some sort of mixed system or market socialism would precede a participatory economy, potentially initiated by the introduction of a Green New Deal in advanced economies (2021, p. 162).

Saros (2014) points out that Parecon does not adequately address the problems highlighted by Austrian economists in the Socialist Calculation Debate, particularly the issue of efficient information transmission:

‘It is true that workers’ councils and consumers’ councils submit work proposals and consumption proposals, but exactly how all this information is transmitted and used rapidly to adjust indicative prices is something that is difficult to imagine.’

(Saros 2014, p. 161)

#### 4.3 Daniel E. Saros – General Catalog (Amazon Socialism)

Rejecting central planning, market socialism, and Parecon, Saros proposes a new form of decentralized planning with specific ‘socialist laws of motion’ (Saros 2014, p. 171). His central argument is that productive forces, especially information technology, were not sufficiently developed at the time of the original Socialist Calculation Debate or the Soviet Union to enable a functioning economic planning system.

##### 4.3.1 Planning system

As in Parecon, enterprises in Saros’s system are organized in workers’ councils. The means of production are owned collectively which means that workers don’t own the enterprise but serve as its legal guardians. They ‘post’ use-values<sup>6</sup> on a digital platform called the General Catalog. Individuals, who all have access to the platform via a unique identification number, search the Catalog and register their needs in a ranked

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<sup>6</sup> Saros refers to the products and services as use-values, distinguishing them from capitalist commodities. Exchange-values do not exist in his model.

needs profile (p. 173). This is to ensure individual choice and provides consumers with the freedom to set their own priorities. The resemblance of such a platform to a visit to Amazon's website led Willoughby (2018) to call Saros's approach 'Amazon Socialism'.

Enterprises receive points according to the need for their posted use values. These points can be used to acquire the necessary inputs from other enterprises. During a multi-step process, the registered needs and available labour and material resources are allocated to achieve a near-optimum solution, taking into account everyone's preferences.

Consumers can purchase any use-values they wish, although they get substantial benefits if they only purchase those use-values that they have previously registered in their needs profile. There is an additional bonus for people who consume less use-values than the average (pp. 175-76). Therefore, '[i]ndividuals have an incentive to plan for future purchases and an incentive to limit communicated needs' (p. 176). This addresses both ecological constraints and information sharing. In contrast to the Soviet Union, people under this model have an inherent motivation to provide accurate information.

Planning takes place in five phases:

'1) the mandatory registration period, 2) the point allocation time period, 3) the input acquisition time period, 4) the production and transportation time period, and 5) the mandatory purchase period.'

(Saros, 2014, p. 177)

These phases are not synchronized throughout the whole system but rather overlap for different types of use values. As Saros writes, '[u]nder normal conditions, a single enterprise will, therefore, continuously be involved in the activities associated with all of the different time periods' (2014, p. 178). 'Mandatory' in phases 1 and 5 only indicates that people have to register/purchase use-values within these phases if they want to receive the aforementioned bonuses but they are not forced to do so. Prices are set by the respective enterprises. Within the purchase period, they can be adjusted ensuring that all use-values will be purchased, eliminating over- and underproduction (p. 186). To ensure sustainable resource use, a scientific council is established and provided with sufficient resources to determine limits on resource extraction, greenhouse gas emissions, etc. (p. 181).

Workers in enterprises are remunerated with credits which they can use to purchase use-values. In addition to a basic income for everyone in education or work, income depends on the number of years a person has worked in a particular field, work effort, and desirability of the type of work. This is to encourage specialisation, enhancing the system's overall efficiency. Worker councils have only limited direct influence on their workers' incomes but can freely adjust the length of their workweek and vacation to indirectly influence hourly wages (pp. 185-87). Credits and points are not equivalent to money in a capitalist system as they are no medium of exchange and cannot be used to acquire means of production:

‘Once the income is spent ... the credits are recorded, but they have no further role to play in the economic system. They are not used to purchase inputs as the revenues of capitalist firms are, and they do not contribute to enterprise profits, which is a category that simply does not exist.’

(Saros, 2014, p. 186)

#### 4.3.2 Democracy & participation

The whole system is designed around the direct participation of people in production and consumption decisions. Some decisions (for example, the credit income for people caring for their own children) are decided by public referendum. The model also has some technocratic elements, namely the system administration, the scientific council, and the employment agency. These institutions are automatically put near the top of everyone's needs profile to ensure their functionality. The wider democratic framework is not described in further detail.

#### 4.3.3 Discussion

As it radically breaks with capitalist laws of motion, Saros's system may seem somewhat chaotic and overly complex at first. But it follows a stringent and coherent logic that Morozov (2019) called an ‘elegant solution’.

A strength of Saros's proposals is that he establishes some guidelines for the transitory period when capitalist and socialist enterprises, capitalist currency, and credits/points exist simultaneously. For example, while there should be strict limits in transferring credits to other individuals, currency savings could be transferred via a fixed exchange rate to credits in order to strengthen the new system (pp. 230-31).

The possibility to individually register and rank needs on a digital platform seems more practicable for day-to-day life than an annual planning conference as proposed by Parecon. For consumers, it won't be that much different from putting products on their Amazon wish list. However, this aspect of the system also presents a downside, as it requires near-constant access to computers and the internet. While Saros thought of provisions for natural disasters and internet blackouts, he does not address some psychological aspects of using his system. Not everyone may have the ability or willingness to use such a digital platform to register their daily needs. Additionally, it could lead to distrust, as most people will not fully comprehend how the algorithms of the General Catalog operate or who can access the data.

## 4.4 Intersections with Degrowth

### 4.4.1 Material dimension

Cockshott & Cottrell explicitly criticize the use of GDP growth as a welfare indicator but their model still assumes continuous economic growth. This could be attributed to the proposal's age, as concerns about growth during the time of publication primarily centred around the finiteness of fossil fuels rather than on climate change and planetary boundaries. In their model, the degree of exploitation of natural resources would be determined either through public referenda or by planning experts. Parecon has a mechanism to include local and global pollutants in the planning procedure and environmental planning. Depending on its specific design, the generational equity constraint could effectively set limits to economic growth during long-term planning. However, it is not assured that this approach would result in an overall reduction of material throughput compatible with Degrowth. While New Socialism does not have an in-built mechanism to restrict resource use in accordance with planetary boundaries, the scientific council proposed by Saros exists explicitly for that purpose. Still, as all models seek to eliminate the need for accumulation inherent to capitalism, their material and energy throughput would likely decline compared to the status quo.

For the Degrowth economy, the presented planning models could serve as valuable tools to achieve an equitable downscaling of production and consumption on a large scale. While deliberative councils could establish upper limits, the detailed coordination of production and resource allocation could be facilitated through one of the democratic planning models outlined above. The participatory nature of Parecon



and Saros's General Catalog ensures a fair distribution, which could, in turn, increase public support for consumption restrictions.

#### 4.4.2 Redefining 'the economy'

All three models have the common aim of abolishing profit and instead focus on meeting human needs, with Parecon and General Catalog granting individuals significant autonomy in defining their own material needs. Meanwhile, Degrowth also seeks to enhance non-material wealth, such as interpersonal relationships and a sense of purpose in life. In one way or another, the planning models all aim to reduce or eliminate unempowering and alienating work, which could contribute to this objective. Another shared feature among the three models is their aim to reduce average working time, which is also a commonly suggested Degrowth policy. Parecon prioritizes public over private consumption which complements Degrowth's preference for a greatly enhanced role of commons.

Still, all planning models primarily centre on organising the allocation of products and services. Immaterial wealth, such as healthy social relationships and supportive communities, cannot be 'planned' in the same way as they defy the logic of quantification. Thus, while the planning system would facilitate the provision for people's material needs, other aspects of the Degrowth economy must be established by other means. Technological and social innovations could complement each other in achieving the collective sufficiency envisioned by Degrowth proponents.

The care sector, which is central to the Degrowth economy, is somewhat overlooked in two of the proposals. New Socialism suggests either collectivising care within communes or leaving it in private hands, while Saros acknowledges its significance but does not go into further detail regarding its organisation.

More recent publications on Parecon, however, place greater emphasis on reproductive labour. Acknowledging that 'the organization, performance, and compensation [of reproductive labour] has historically been gender biased, unfair, and inefficient' (Hahnel, 2021, p. 196), Parecon seeks a rebalancing and fair compensation for such work. They suggest job balancing committees within worker councils should have women's caucuses which ensure a fair distribution of reproductive labour within an enterprise. As in all other jobs, reproductive labour in the public sphere (like education, healthcare, child & elderly care) shall be remunerated based on effort and

sacrifice, not on productivity. This would re-valuate care work relative to jobs in other sectors. Hahnel further suggests compensation for in-household care work by treating caregivers in a private setting as '*ex-officio employee[s]*' (2021, p. 204) of the healthcare or education system and remunerated them accordingly.

#### 4.4.3 Technology

The models proposed by Cockshott & Cottrell, Saros, and to a lesser extent, Parecon all rely on highly technologized systems. There is some well-founded scepticism towards vast technological systems within parts of the Degrowth movement. They point towards such risks as the subjugation of social life to quantification and rationalisation, which may restrict people's autonomy by nudging them towards optimized behaviour.

To be compatible with the Degrowth vision, planning systems should therefore adhere to the principles of conviviality. They must be accessible and adaptable, ensuring democratic accountability of administrators and transparency about their workings. Additionally, these systems should refrain from gathering personal data unless it is strictly necessary for the planning process.

#### 4.4.4 Democratisation

All the discussed models strive to enable citizen participation in economic decision-making, which aligns with one of the core objectives of Degrowth. Additionally, these three models establish democratic control over the means of production. In that regard, the extent of economic democratisation even goes beyond some of the more moderate Degrowth currents which do not explicitly call for a collectivisation of the means of production. However, implementing such collectivisation does not conflict with the objectives of Degrowth. Parecon's planning approach appears to align particularly well with Degrowth's preference for deliberative democracy, while New Socialism and Saros's model have a stronger focus on technological mediation.

While all the models align with Degrowth's overarching objective of economic democratization, there is a need for further evaluation of the democratic institutions and rules that would accompany the Degrowth economy and the transformation process. The democratic structure accompanying the planning model is only presented in detail by Cockshott & Cottrell, while Saros is the only one to deliver a clearly sketched-out transformational path.

## 5 Planning for Degrowth

### 5.1 Lessons from the calculation debate and management cybernetics

While the computation problem has become irrelevant today, any economic planning system must provide solutions to the knowledge problem. Digital platforms can help to address this issue by enabling the direct registration of needs without the need for price signals. This is already practiced by corporations and is also essential for the General Catalog proposed by Saros (2014).

The third point raised by critics of economic planning concerns discovery and innovation. However, the understanding of innovation differs significantly between capitalist market economies and Degrowth. Degrowth places less emphasis on technological innovations themselves but rather on innovations in the social utilisation of these technologies. For instance, planned obsolescence is rejected, leading to the creation of longer-lasting products that offer possibilities for adaptation and repurposing. In areas where further technological development is required, such as renewable energies or medicine, investments in research can be made directly, determined through the democratic allocation of resources (Hickel, 2023).

Cybernetic approaches are valuable for ‘taming’ the variety of complex systems and making them more manageable. Additionally, these approaches offer essential theories to design decentralized yet powerful systems, such as digital planning platforms.

### 5.2 Lessons from real-world planning

#### 5.2.1 Soviet Union

Although the Soviet economy bore little resemblance to Degrowth principles, it offers valuable insights for democratic economic planning. The core lesson is the imperative of ensuring a free flow of information, which requires incentives for people to truthfully share information (Cockshott & Cottrell, 1993). Additionally, openness to new ideas and being receptive to changes in the planning mechanism is of great importance. Unfortunately, promising reforms ideas were often discarded due to

highly unequal power relations within the Soviet bureaucracy. Furthermore, the adaptability of planning is crucial to effectively address changing needs and external factors. The 5-year-plans tended to be too inflexible and incoherent for that matter.

### 5.2.2 CyberSyn

Medina (2014) highlights the ability of CyberSyn's designers to use the available resources and outdated technology to create a tailor-made and adaptable solution to the issues faced by the Chilean government. This repurposing of already available technologies for an emancipatory cause corresponds well to the convivial use of technology promoted by Degrowth. For those within the Degrowth community who are particularly sceptical of large-scale technological systems, CyberSyn could serve as a demonstration that socio-technical systems can indeed be designed to emancipatory ends.

Medina also emphasizes the malleability of socio-technical systems like CyberSyn. She argues that even though its developers tried to design it as 'a system that supported such values as democracy, participation, and autonomy' (2014, p. 209) it could also have been abused as a tool for top-down control. When designing technological infrastructures for democratic planning, this should be always kept in mind. High standards for data protection, accountability of system administrators, transparency regarding the system's algorithms, and democratic control of the infrastructure are essential requirements.

### 5.2.3 British War Economy

The British war economy is an example of the state's capability to swiftly transform an economy when faced with an imminent threat. In times of crisis, limitations and rationing of certain goods can be broadly accepted if there is a shared sense of purpose and if it is executed in a socially equitable way, with support provided for the less privileged parts of the population.

However, as Herrmann (2022) acknowledges, the example can only be applied to the Degrowth transformation to a limited extent. The high public acceptance was in part due to the strong motivation of people to win, or at least survive, the war, coupled with the belief that these measures were temporary and that things would eventually

return to normal. This differs from the Degrowth transformation, which requires sustained and systemic changes.

#### 5.2.4 Amazon, Walmart & Co.

Although they can certainly not serve as role models for Degrowth, Amazon and other corporations prove that the coordination of complex value chains without price signals is possible. They also show that prices are not necessary to determine the demand for certain products. As suggested by Saros (2014), Amazon's standardized and easy-to-use user interface could serve as an inspiration for a public digital platform that people can use to register their needs.

### 5.3 Democratic planning models

All three planning models examined have significant overlaps with the objectives of the Degrowth movement. Particularly, Parecon and the General Catalog demonstrate great potential to support the Degrowth economy by complementing its well-established principles of deliberative democracy with a large-scale economic coordination mechanism. Their primary mechanisms to reduce resource and energy throughput – Parecon's generational equity constraint and Saros's scientific council – could be combined to strike a compromise between efficacy, practicability, and democratic participation. In earlier democratic planning models, care and reproductive labour were often underrepresented. However, recent publications on Parecon have incorporated insights from feminist theory into the planning model, revaluing the importance of reproductive labour for the economy. The models further enhance the debate by providing clearer insights into the social relations of production and the necessity to establish alternatives to capitalist laws of motion, aspects sometimes lacking in the Degrowth literature.

Cooperatives or ecovillages that are already applying Degrowth principles could become pioneers in adopting the new planning system. Scaling up the Degrowth economy from scattered local 'nowtopias' and establishing a democratic economic planning system will be an immense and prolonged challenge, with no guarantee of success. The transformation will require a determined and diverse social movement that is willing to confront the status quo.

Concerning the transformation, I side with Herrmann (2022) in arguing that the state, in its current form, will need to engage in some form of emergency planning akin to

war-time efforts described above. This is due to the immense time pressure to swiftly reduce greenhouse gas emissions and ecological destruction. Decisions concerning the required limits on resource use, consumption, and the rationing of certain goods should be made by citizens' councils guiding the government in the process.

However, for the medium and long-term, such a top-down mode of governance would not be desirable as it would fail to break with capitalist accumulation and inadequately enable the direct participation of citizens and workers in the economy. At this stage, the discussed planning models could come into play. Saros's model in particular stands out as it offers a clear outline for the gradual introduction of the new mode of production.

Conflicts could potentially arise along the following lines:

- Localized production, small value-chains vs. integrated large-scale production
- Convivial technology use vs. all-encompassing technological planning system
- Immaterial wealth, subjective wellbeing vs. increasing valorisation and quantification of human activities and life on Earth.

## 5.4 Conclusion & Outlook

In this paper, I sought to address a gap in the Degrowth literature concerning the mechanism of economic coordination. Looking at historical and contemporary debates on economic planning, I identified democratic participation, the free flow of information, and safeguards against power abuse as vital requirements for effective economic planning.

Modern information technology, including AI and cybernetics, efficiently processes vast amounts of data and optimizes solutions to complex problems. However, these technologies alone cannot solve the challenge of gathering the necessary information for economic planning which requires decentralized, participatory procedures using digital platforms. Democratic economic planning through digital feedback infrastructures shows significant potential to complement Degrowth's established democratic principles. Data protection and transparency are vital to ensure a truly democratic digital infrastructure and to safeguard against abuse. Computerized planning should, however, not entirely replace deliberative forums and citizen's councils advocated by the Degrowth literature. Deliberation on socio-economic

objectives and technological development remains crucial and cannot be reduced to a mere optimisation problem to be 'solved' by algorithms.

Participatory planning approaches like Parecon or Daniel Saros's model appear most compatible with the objectives of the Degrowth movement. Thoughtfully implemented, they could facilitate equitable downscaling of production while meeting human needs, offer a high level of local autonomy, enable bottom-up knowledge production, promote convivial technology use, and allow for democratic deliberation about overarching political objectives.

Still, there are some fundamental questions that need to be addressed:

- **Money/unit of account**

Concerning the role of money, the discussed planning models vary greatly. Considering the likely coexistence of both 'old' and 'new' forms of production during a transitory period, a crucial question arises: How will exchange between these different systems be arranged? Resolving this issue is essential in presenting a credible transformation path.

- **Trade**

Closely related is the issue of international trade which will still be necessary and desirable in a re-localized Degrowth economy, though to a lesser extent. As capitalist nations, nations with a democratic planning system and various intermediate forms will exist at the same time, how can trade between those nations be arranged?

- **Democratic institutions**

The institutional environment necessary to enable a Degrowth economy and democratic economic planning need to be investigated further. The relationship to the state and its future role is of particular relevance.

- **Privacy protection and abuse potential**

Who will operate the digital infrastructures that carry out economic planning? How can data protection be maximized, and abuse potential be minimized? How to deal with the potential emergence of shadow currencies in a moneyless system?

In this paper, I could provide only a cursory assessment of the different economic planning models and their intersections with Degrowth. More in-depth analyses of specific models and how they can be applied in Degrowth economies are necessary.



## References

- 8th & Walton. (2022). *Collaborative Planning, Forecasting and Replenishment (CPFR)*. 8thandwalton. <https://www.8thandwalton.com/blog/cpfr/>
- Albert, M., & Hahnel, R. (1991). *The political economy of participatory economics*. Princeton University Press, Princeton (New Jersey).
- Allen, R. C. (2001). The rise and decline of the Soviet economy. *Canadian Journal of Economics/Revue Canadienne d'Economie*, 34(4), 859–881. <https://doi.org/10.1111/0008-4085.00103>
- Asara, V., Profumi, E., & Kallis, G. (2013). Degrowth, Democracy and Autonomy. *Environmental Values*, 22(2), 217–239. <https://doi.org/10.3197/096327113X13581561725239>
- Banerjee, S. B., Jermier, J. M., Peredo, A. M., Perey, R., & Reichel, A. (2021). Theoretical perspectives on organizations and organizing in a post-growth era. *Organization*, 28(3), 337–357. <https://doi.org/10.1177/1350508420973629>
- Beer, S. (1967). *Cybernetics and Management* (2nd ed.). English Universities Press, London.
- Boettke, P. J., & Candela, R. A. (2023). On the feasibility of technosocialism. *Journal of Economic Behavior & Organization*, 205, 44–54. <https://doi.org/10.1016/j.jebo.2022.10.046>
- Brossmann, J., & Islar, M. (2020). Living degrowth? Investigating degrowth practices through performative methods. *Sustainability Science*, 15(3), 917–930. <https://doi.org/10.1007/s11625-019-00756-y>
- Cattaneo, C., D'Alisa, G., Kallis, G., & Zografos, C. (2012). Degrowth futures and democracy. *Futures*, 44(6), 515–523. <https://doi.org/10.1016/j.futures.2012.03.012>
- Cockshott, W. P., & Cottrell, A. (1993). *Towards a new socialism*. Spokesman, Nottingham.
- Cottrell, A., & Cockshott, W. P. (1993). Calculation, complexity and planning: The socialist calculation debate once again. *Review of Political Economy*, 5(1), 73–112. <https://doi.org/10.1080/095382593000000005>
- Duvic-Paoli, L.-A. (2022). Re-imagining the Making of Climate Law and Policy in Citizens' Assemblies. *Transnational Environmental Law*, 1–27. <https://doi.org/10.1017/S2047102521000339>
- Dyer-Witthford, N. (2013). Red Plenty Platforms. *Culture Machine*, 14.

- Fitzpatrick, N., Parrique, T., & Cosme, I. (2022). Exploring degrowth policy proposals: A systematic mapping with thematic synthesis. *Journal of Cleaner Production*, 365, 132764. <https://doi.org/10.1016/j.jclepro.2022.132764>
- Gardiner, M. E. (2022). Automatic for the People? Cybernetics and Left-Accelerationism. *Constellations*, 29(2), 131–145. <https://doi.org/10.1111/1467-8675.12528>
- Gare, A. (2002). The Environmental Record of the Soviet Union. *Capitalism Nature Socialism*, 13(3), 52–72. <https://doi.org/10.1080/10455750208565489>
- Gough, I. (2021). Two Scenarios for Sustainable Welfare: A Framework for an Eco-Social Contract. *Social Policy and Society*, 1–13. <https://doi.org/10.1017/S1474746421000701>
- Haberl, H., Wiedenhofer, D., Virág, D., Kalt, G., Plank, B., Brockway, P., Fishman, T., Hausknost, D., Krausmann, F., Leon-Gruchalski, B., Mayer, A., Pichler, M., Schaffartzik, A., Sousa, T., Streeck, J., & Creutzig, F. (2020). A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: Synthesizing the insights. *Environmental Research Letters*, 15(6), 065003. <https://doi.org/10.1088/1748-9326/ab842a>
- Haenlein, M., & Kaplan, A. (2019). A Brief History of Artificial Intelligence: On the Past, Present, and Future of Artificial Intelligence. *California Management Review*, 61(4), 5–14. <https://doi.org/10.1177/0008125619864925>
- Hahnel, R. (2021). *Democratic economic planning*. Routledge, London.
- Herrmann, U. (2022). *Das Ende des Kapitalismus: Warum Wachstum und Klimaschutz nicht vereinbar sind-und wie wir in Zukunft leben werden* (2. Auflage). Kiepenheuer & Witsch, Köln.
- Hickel, J. (2021). What does degrowth mean? A few points of clarification. *Globalizations*, 18(7), 1105–1111. <https://doi.org/10.1080/14747731.2020.1812222>
- Hickel, J. (2022). *Less is more: How degrowth will save the world*. Penguin Books, London.
- Hickel, J. (2023). On Technology and Degrowth. *Monthly Review*, 75(3).
- Hickel, J., & Kallis, G. (2020). Is Green Growth Possible? *New Political Economy*, 25(4), 469–486. <https://doi.org/10.1080/13563467.2019.1598964>
- Hickel, J., Kallis, G., Jackson, T., O'Neill, D. W., Schor, J. B., Steinberger, J. K., Victor, P. A., & Ürge-Vorsatz, D. (2022). Degrowth can work—Here's how science can help. *Nature*, 612(7940), 400–403. <https://doi.org/10.1038/d41586-022-04412-x>

- Howlett, P. (1993). New Light through Old Windows: A New Perspective on the British Economy in the Second World War. *Journal of Contemporary History*, 28(2), 361–379.
- Joutsenvirta, M. (2016). A practice approach to the institutionalization of economic degrowth. *Ecological Economics*, 128, 23–32. <https://doi.org/10.1016/j.ecolecon.2016.04.006>
- Medina, E. (2014). *Cybernetic revolutionaries: Technology and politics in Allende's Chile*. The MIT Press, Cambridge (Massachusetts).
- Morozov, E. (2019). Digital Socialism? The Calculation Debate in the Age of Big Data. *New Left Review*, 116/117.
- Ott, K. (2012). Variants of de-growth and deliberative democracy: A Habermasian proposal. *Futures*, 44(6), 571–581. <https://doi.org/10.1016/j.futures.2012.03.018>
- Parrique, T., Barth, J., Briens, F., Kerschner, C., Kraus-Polk, A., Kuokkanen, A., & Spangenberg, J. H. (2019). *Decoupling Debunked: Evidence and arguments against green growth as a sole strategy for sustainability*. European Environmental Bureau.
- Participatory Economy Project. (n.d.). *Is there money in a Participatory Economy?* Participatoryeconomy.Org. Retrieved 19 July 2023, from <https://participatoryeconomy.org/faqs/is-there-money-in-a-participatory-economy/>
- Phillips, L., & Rozworski, M. (2019). *The People's republic of Walmart: How the world's biggest corporations are laying the foundation for socialism*. Verso, London.
- Romano, O. (2012). How to rebuild democracy, re-thinking degrowth. *Futures*, 44(6), 582–589. <https://doi.org/10.1016/j.futures.2012.03.019>
- Saito, K. (2023). *Marx in the Anthropocene: Towards the Idea of Degrowth Communism* (1st ed.). Cambridge University Press, Cambridge (England). <https://doi.org/10.1017/9781108933544>
- Saros, D. E. (2014). *Information technology and socialist construction: The end of capital and the transition to socialism*. Routledge, Taylor & Francis Group, New York.
- Schaupp, S. (2019). Radikale Demokratie und Kybernetik. In D. Comtesse, O. Flügel-Martinsen, F. Martinsen, & M. Nonhoff (Ed.), *Radikale Demokratietheorie. Ein Handbuch* (pp. 764–776). Suhrkamp, Berlin.
- Schmelzer, M., & Vetter, A. (2021). *Degrowth/Postwachstum zur Einführung* (3., unveränderte Auflage). Junius, Hamburg.

- Schmelzer, M., Vetter, A., & Vansintjan, A. (2022). *The future is degrowth: A guide to a world beyond capitalism*. Verso Books, London.
- Singer, S. (2023). 'The Future is Degrowth' and 'Degrowth & Strategy': A Review in Dialogue. Degrowth.Info. <https://degrowth.info/en/blog/the-future-is-degrowth-and-degrowth-strategy-a-review-in-dialogue>
- Srnicek, N. (2020). *Plattform-Kapitalismus* (U. Schäfer, Trans.; 2. Auflage). Hamburger Edition, Hamburg.
- Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., Hakala, E., & Eronen, J. T. (2020). Decoupling for ecological sustainability: A categorisation and review of research literature. *Environmental Science & Policy*, 112, 236–244. <https://doi.org/10.1016/j.envsci.2020.06.016>
- Volkswagen. (2021). *Fully integrated: Volkswagen builds Industrial Cloud for all plants*. Volkswagen Group News. <https://www.volkswagen-newsroom.com/en/stories/fully-integrated-volkswagen-builds-industrial-cloud-for-all-plants-6965>
- West, D. K. (2020). Cybernetics for the command economy: Foregrounding entropy in late Soviet planning. *History of the Human Sciences*, 33(1), 36–51. <https://doi.org/10.1177/0952695119886520>
- Willoughby, J. (2018). Book Review: Information Technology and Socialist Construction: The End of Capital and the Transition to Socialism. *Review of Radical Political Economics*, 50(2), 427–429. <https://doi.org/10.1177/0486613416665833>

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