

Socialist Planning in the Era of Climate Change

David Zachariah and Tomas Härdin

July, 2026

Introduction

The case for socialism is often laid out on moral grounds. It is said that socialism will put people before profits; that it will end the unjust servitude of labor to the upper classes; and that it will bring about equal opportunities for individuals to flourish.¹ This cannot be achieved by a mere redistribution of wealth, since modern societies rest upon the mobilization of labor with large-scale interdependent productive assets – such as mines, railways, power plants and hospitals. These assets are not amenable to direct redistribution, and therefore the promises of socialism can be realized only through their *collective* utilization. We will therefore use a broad definition of a *socialist economy* as one in which the working population exerts political control over the utilization of these assets.²

Yet, the desirability of socialism is not sufficient to render it feasible. A socialist economy cannot simply be wished into existence. Its *economic* feasibility rests on the possibility of building it out of elements from the existing capitalist environment within the lifespan of a given population. At the same time, the *political* feasibility of socialism requires it to address problems impeding the material well-being for a vast majority. We cannot expect to build mass movements with members committed to undertaking the risks of economic transformation, or defending its outcome, unless socialism can demonstrate successive gains over capitalism.³ We take these economic and political requirements to be the elementary *feasibility conditions* of socialism. They relegate all designs predicated on unconstrained abundance or widespread altruistic behaviors to the realm of science fiction and utopian speculation. Such designs lack strategic relevance for socialist movements aiming to build institutions that operate in a world constrained by material incentives, divisions of labor, and territorially bounded nation states.

In the advanced countries of the 1930s, a feasible socialism had to offer full employment and modernizing investments amidst capitalist stagnation and mass unemployment. In the 1960s, by contrast, it had to offer gains beyond the concessions won by organized labor under state-led, full employment growth paths. In the 2030s, the tightening of resource constraints through climate changes, geopolitical conflict and demographic decline places new requirements on what socialism must plausibly deliver. Current projections estimate that the effects of climate changes alone will depress average real incomes across most of the world over the coming twenty-five years due to declining labor and agricultural productivity as well as rising costs of environmental damages.⁴ Worse still, the livelihoods and essential needs of the masses are put at stake as the severity of heat waves, forest fires and floods continually increases. The problems of adapting to and mitigating these conditions alter the coordinates of socialist politics. Relative to a deteriorating capitalist environment, a feasible socialist economy must possess the capacity to *secure* a range of resources required for the well-being of its population, while *limiting* the quantities of extracted critical resources and emitted waste products.

¹See for instance Cohen (2009); Roemer (2017); Vrousalis (2021).

²On one hand, this definition is consonant with a materialist conception in which economic systems are distinguished by their means of extracting and appropriating labor. On the other hand, it avoids utopian idealist conceptions of socialism by underscoring that the socialist character of an economy is a matter of degree, since the forms of political control can be more or less direct and encompassing.

³For discussions about the economic and political feasibility of socialism, see Nove (1991) and Przeworski (1985), respectively.

⁴See e.g. Kotz et al. (2024).

In these circumstances, the conditions of feasibility form a serious challenge to any socialist economy based on workers' cooperatives or labor-managed firms, in which resource allocation is determined through *decentralized* market interactions.⁵ The Austrian Marxist Otto Neurath argued already at the beginning of the previous century that market allocation squanders society's ultimate resources: both human labor and the gifts of nature. He illustrated this by the example of coal, a finite resource that was put to waste for use in heating rather than in the production of useful chemicals where it could not readily be substituted.⁶ Around the same time, neoclassical economists, such as Arthur Pigou, also realized that producers' failure to take into account the 'external' effects of their decisions could lead to resource allocations that would leave all worse off than if they were to coordinate their decisions.

However, market regulation simply lacks the requisite *information* to steer millions of firms to meet collective needs within specified physical constraints. This is because the production of one firm depends on that of many others in a complex production network, yet operates under commercial competition and secrecy. No regulatory body has information to determine price adjustments of fossil fuels so as to direct their overall usage. Nor can such a body assess how a cap on their production will affect investments in railways or the provision of medical supplies. The result of using either regulatory instrument is to overshoot constraints or a failure to meet needs. The uncertainties that a regulatory body faces render the very choice of effective instruments ambiguous, even within idealized economic models.⁷ Consequently, under market allocation there is no effective mechanism to limit resource usage or waste products while also satisfying collective needs.

Market allocation is institutionally required to sustain compound rates of return on investments and therefore exponential growth of output. At the same time, it lacks the *capacity* to raise investments that can tackle economic problems emerging in the era of climate change. Adaptation requires massively fortifying critical supply systems; the construction of defenses against rising sea-levels; and the transfer of coastal cities towards the inland. Mitigation requires a transformation towards an energy system based on stable non-fossil sources; an electrification of the transportation system; a modernization of the housing stock; the rewilding of forests; and so on. Stemming the demographic decline is likely to require a substantial transfer of investments towards supporting human reproduction. In this light, the more recent 'degrowth' paradigm, which focuses on downscaling material throughput, also fails to meet conditions of feasibility as it risks imposing austerity on the masses.⁸

In these circumstances, the feasibility conditions for socialism necessitate *planning*, which one of its early Scandinavian theorists argued is motivated by a need to coordinate immediate and future economic actions.⁹ For instance, the winding down of fossil fuel production in ten years must be coordinated with the ability to secure electrification and living standards beyond that period to be feasible.¹⁰ Thus planning is a particular *type* of economic regulation to meet politically defined *goals* over time. If our assessment above is correct, it means that planning must once again become a central, albeit not exhaustive, element of socialist economic policy.

Historically, the *promise* of socialist planning carried most weight during periods of depression, destruction and development. An illustration is provided by the post-war program adopted by the Swedish labor movement in 1944: "We do not have to resign ourselves to unemployment, and we can abolish destitution, provided that the productive power, which the war revealed us

⁵Prominent examples include Roemer (1994), Schweickart (2002) and, more recently, Beggs (2022).

⁶Neurath (1919), cited in Uebel (2005).

⁷See for instance Weitzman (1974).

⁸See also Hickel and Sullivan (2024).

⁹Svennilson (1965). Svennilson was pioneering research on planning in the West in the 1930s.

¹⁰Thus disrupting the fossil energy base – either by legal means or by sabotage as advocated by Malm (2021) – *without* the planned construction of an alternative one is a politically infeasible strategy.

to possess, is used with similar expedience for peacetime purposes. The main task before us is to coordinate economic activities into a planned economic system, so that the labor force and the material assets are utilized for efficient production all the time. Such coordination ought to take place under the direction of society and should be so arranged that private interests are subordinated to the goals for which we strive collectively.”¹¹ In the era of climate change, the *main task* of socialist planning is to meet collective needs within specified resource constraints through an efficient use of common resources.

Since the demise of Soviet-type planning, there is a small but growing number of proposals that make the case for alternative planning models.¹² While they have widened the imagination of socialist thought, we believe they have not adequately tackled fundamental problems of information and incentives that arise in the coordination of large economic organizations. They are, moreover, models formulated largely outside the constraints of political feasibility.

In the following pages, we will first outline an institutional structure for socialist planning that aims to meet collective needs within specified resource constraints.¹³ We argue that the political feasibility of such a structure will increase in the era of climate change. We then turn to the problems of information and incentives, using Soviet-type planning as a historical example. Finally, we describe a planning procedure that tackles these fundamental problems as a mode of anticipatory economic regulation designed to complement the autonomous regulation by enterprises.¹⁴

Planning – Purpose and Scope

To meet collectively defined needs under resource constraints, a feasible socialist economy needs institutions that *fuse* political and productive power in some manner. This raises a series of questions:

1. What should be the scope of planning?
2. What are its structural constraints?
3. How should its collective goals be determined?
4. How should it function as a process of economic regulation?

We consider each question in turn below.

Scope of planning

The reproduction of *any* industrialized economy, socialist or otherwise, involves a planned sector, a market sector, households and an external sector. The households supply labor power, while the external sector supplies products that are impossible or too costly to produce domestically.

¹¹Arbetarrörelsens efterkrigsprogram – De 27 punkterna med motivering, <https://www.marxistarkiv.se/sverige/socialdemokratin/efterkrigsprogrammet.pdf>.

¹²Representative examples include Devine (1988), Cockshott and Cottrell (1993), Albert and Hahnel (1991) as well as the special issues of *Science & Society* on socialist visions, published in 1992, 2002, 2012 and 2022. For a comparison, see Legault and Tremblay-Pepin (2021). More recent proposals discussing socialist planning include Phillips and Rozworski (2019), Vettese and Pendergrass (2022), Cockshott et al. (2022), Hannah (2024) and Benanav (2025a,b). See also Gindin (2018), Grünberg (2025) and Ackerman (2026) for a critical discussion.

¹³This work has benefitted from constructive feedback from Moshé Machover, Emmanuel Farjoun, Sam Gindin, Adaner Usmani and Petter Nilsson.

¹⁴Our perspective is informed by the study of autonomous economic control, which was a research program initiated by Hungarian economists who drew upon insights from the transition to the New Economic Mechanism of 1968. See Kornai and Martos (1973), Kornai and Martos (1981) and Martos (1990). The study of feedback control in general and in production systems was pioneered by Wiener (1948) and Simon (1952), respectively. The control-theoretic perspective has also recently been rediscovered by Steblev and Kallis (2025).

The planned sector utilizes assets that are collectively owned and we will refer to its units of production simply as *enterprises*. This sector includes, among other things, education, healthcare and many utilities. For concreteness, we will assume public ownership, but other legal forms are conceivable.

Since the requirements for running a hospital or constructing a railway line are very different, the management structure of each enterprise must vary with the nature of work and its internal division of labor. Even across similar enterprises, however, workers' preferences may differ in how their workplaces should be managed. Some may prefer highly participatory forms, others may settle on simply selecting their managers. It is a matter to be stipulated in the statutes of each enterprise. Our only assumption here is that workers of an enterprise have an interest in keeping it *operational*.

The appropriate division between the planned and market sectors has been a longstanding debate in socialist economics. The classical socialist perspective was to take aim at the 'commanding heights' of the economy but we think it fails to provide adequate guidance in modern-day economies. Not all needs of society are to be collectively defined. There is a very large set of *individual* needs and preferences for consumer products that play no meaningful role in democratic deliberation.¹⁵ On the other hand, society must collectively deliberate over *common* physical constraints, such as limited quantities of fresh water consumption, area of land use, or barrels of crude oil produced, which do impinge on these needs. To address the asymmetry between individual needs and common constraints, we adopt a *public utilities* perspective, which is concerned with the provision of public goods and the 'external' effects of economic decisions.

Utilities are meant to supply goods and services that are considered 'essential' or 'vital' in some economic sense. In an industrialized economy it becomes clear that certain product types – say, electrical power, steel, cement and so on – enter directly or indirectly into the production of every product and are therefore *essential* for the overall economic process.¹⁶ Without power generation, transportation, or water, there is no chance of securing a viable economy at large. Similarly, there are *vital* products which are directly and indirectly required to meet the collective needs of the working population. These include healthcare, housing and commuting services, and should be subject to universal provision. From a public utilities perspective then, the planned sector should include workplaces that generate the *bulk of society's essential and vital products*. If we take the current structure of the US economy as an example, then roughly half of total employment would be in the planned sector. It would include a significant portion of workers in the energy sector, transportation, logistics, telecommunications, manufacturing, construction, mining, agriculture as well as health care and basic education. This still leaves a substantial market sector to supply final products for private consumption.

The functional asymmetry between planned and market sectors achieves two things. On the one hand, the planned sector directs the supply chain of essential products which *erodes* market dependence and *imposes* physical constraints on production in the market sector. For instance, it can limit the supply of fossil fuels to prioritized sectors, while offering investment goods that accelerate electrification. Consumer demand in the market sector is also constrained by the products under public provision. For instance, if transportation is made an accessible public good, then the urban demand for private cars will decline.

On the other hand, the planning process is *relieved* of the task of exploring and satisfying individual consumer preferences. Such diverse preferences can change rapidly in response to

¹⁵Schweickart (2006) skewers the idea that individuals should submit periodic private consumption plans to a central planning process.

¹⁶The special role of such basic products in capitalism was first studied formally by the Italian economist Piero Sraffa (Sraffa 1960), who was building on prior work by Quesney and Marx. See also Cockshott and Zachariah (2006) and Zachariah and Cockshott (2020).

supply changes and are rarely possible to consistently specify ex-ante in any detail. Instead, the task is laid upon firms in the market sector, such as restaurants, clothing manufacturers and car repair shops, who *purchase* their essential inputs from the planned sector.¹⁷ A monetary circuit between firms and the planned sector must thus be facilitated. In so far as public banks provide the main line of credit in the economy, capitalist ownership in the market sector is eroded by extending credits to cooperatively or municipally owned firms. In other words, the asymmetry between planned and market sectors enables the former to regulate the development of the latter by *leveraging its political and productive power* towards collectively defined goals.

Structural constraints on planning

The external sector imposes fundamental constraints on this power. First, no industrialized economy can dispense with imports without a major reduction of living standards. Second, socialist planning institutions must adapt to an external sector that is overwhelmingly capitalist. To presume otherwise only begs the question, as it assumes what is yet to be established: large-scale socialist economies. This means that the planned sector is constrained by the need to maintain a balance of payments with the external sector, ultimately financing imports through exported products. The geopolitical conjecture in the capitalist world economy therefore sets constraints for domestic elements of socialist planning that varies across countries.

While a geopolitical analysis is beyond the scope of the present article, we think a planned sector of expanding public utilities can be advanced, in different countries at varying rates, by coalitions of working people politically organized within the essential and vital sectors of the economy. It is well understood that organizing for structural changes within a national capitalist economy risks triggering the decline of confidence among capitalist investors, thereby threatening employment and real income growth which, in turn, aggravate problems of deficits and balance of payments. This would quickly disintegrate mass support for building socialist institutions. In other words, as long as the material welfare of the working population is tightly coupled to concessions made under capitalist growth, the obstacles to structural changes remain formidable.¹⁸

In our view, however, the effects of climate changes, geopolitical conflict and demographic decline increasingly impinge on economic development in a manner that *necessitates political interventions to secure economic viability*. The increased frequency and scope of such interventions has the dual effect of re-opening areas of political contestation over economic structures, while blunting the threat of declining capitalist investment in the market sector and potentially splitting capitalist interests. This opens a space to develop and expand the planned sector.

Securing the joint production of essential and vital products necessitates the expansion of collective institutional capacities, as did the wartime mobilizations of the twentieth century. On the one hand, workers in the essential sectors are endowed with a disruptive potential which gives them disproportionate leverage over political interventions in structural crises.¹⁹ Obstructions in the essential production processes would paralyze the large parts of the economy within a short period of time. On the other hand, they would collectively possess the productive power to erode market dependence and direct economic development towards collectively defined needs. All of this depends, of course, on their *political organization*, which remains the central unresolved strategic issue for socialists in this century.

Collective goals of planning

Collective goals concern *anticipated* economic outcomes and are to be determined through a democratic process of deliberation and contestation over choices and trade-offs. We suggest

¹⁷The functional asymmetry solves the key problems of separating planned and market sectors of production raised in Grossman (1963).

¹⁸A classic analysis of structural obstacles is given in Przeworski (1985).

¹⁹See for instance Usmani (2018).

two institutions for achieving this. First, a *viability assembly* is tasked to determine and revise broad *quantitative goals* that aim to secure a sustainable reproduction of the population over time. This includes required quantities of certain prioritized supplies, such as drinking water, electrical power and grains, but also limits on quantities of specific waste products, land usage or utilization of fresh water supplies.²⁰ In these cases, quantitative goals are superior to monetary instruments.²¹

The participation of groups of scientific advisors in the process would be vital, but the assembly must consist of stakeholders who face the consequences of their own decisions as citizens, workers, and consumers – unlike the heads of existing economic ministries and agencies. Only then can the costs and benefits of decisions (and indecisions) be shared fairly. There are several conceivable mechanisms for selecting representatives among stakeholders, including sortition which minimizes the distortion of the assembly’s class character.²² Regardless of selection mechanism, a central viability assembly determines certain aggregate goals, which will need to take into account information and demands from regional assemblies rooted in local communities.

The assembly sets viability *boundaries* for economic development, but does not determine its *direction*. To do so, the Polish economist Oskar Lange argued, planning institutions must determine the division of resources directed towards investments and consumption, respectively, over time.²³ Specifically, aggregate *sectoral budget allocations* towards, say, the health care and power supply sectors could subsequently be materialized as hospital wards and power plants.²⁴ We envisage that this allocation is determined by the election of *economic programs* proposed by coalitions of political parties, which organize different interests and articulate competing visions of development. Some programs may prioritize allocations for high-speed railway transportation, while others may seek expanded housing with communal luxuries or the rewilding of some regions. It is also through this process that different strategies for adaptation and mitigation to climate changes are politically debated. Elected programs periodically specify budget allocations designated for *investment* and *provision*, respectively, across sectors. This determines the division of the planned sector’s final product.

The budget allocations towards investments and provision are managed by corresponding *sectoral boards*, in analogy to ministries and their regional subdivisions. Their key role is to grant and oversee *budgeted projects* that involve orders from one or more enterprises. For instance, the transportation investment board may grant a railway construction project in which steel is ordered from a steel plant. The power investment board may grant investments to modernize a power plant. *Investment* projects are proposed by a multiplicity of sources, be it municipalities, enterprises or professional organizations. *Provision* projects are set up between external parties and enterprises. For instance, a health council may order insulin from a producer under a health provision project or a municipality may contract electrical power supplies under a power provision project. Thus projects turn collective goals into concrete *orders* with enterprises over time.

Regulatory function of planning

Under the imperative to stay operational, an enterprise will aim to meet its contractually committed orders, striving to maintain its inventories by means of corrective changes to production and internal orders. This engenders an *autonomous* regulation process by interdependent enterprises, which has two desirable properties. First, it is capable of sustaining their joint production in the short run as well as overcoming unforeseen shocks that may arise from a wide range of

²⁰It will also include setting viable limits on the balance of payments in trade over a given time horizon.

²¹See Weitzman (1974).

²²For an alternative to electoral selection, see Burnheim (1985), Cockshott and Cottrell (1993) and Van Reybrouck (2016).

²³Lange (1958).

²⁴Around 10-20 sectors is a manageable division used in national accounts today.

reasons: from broken machines, delivery errors and incorrect orders, to extreme climate events such as floods, fires and droughts.²⁵ Second, it requires neither price adjustments nor central instructions, only self-managed adjustments in response to incoming orders and changes in inventory levels. Given their information about local economic opportunities, enterprises are best suited to explore their own mix of production inputs and outputs they wish to offer to potential users. Thus in the face of uncertainties, interdependent production systems can be regulated autonomously in the short run.

However, autonomous regulation has two important limitations. First, it has no internal mechanism to prioritize the *allocation* of finite resources and productive capacities. If fossil fuel imports are limited by geopolitical conflict or environmental concerns, the process cannot bring about an allocation of such scarce quantities to satisfy collective goals efficiently. Second, autonomous regulation is merely locally *reactive* to changes in the overall collective goals. If projects aim to rapidly change the energy supply mix, the process has no means of jointly securing essential products in a timely manner. This would require that each enterprise can internally represent how future collective goals propagate through the interdependent production system to affect its own production.²⁶ Lacking such capacities, the reactive nature induces delays or cycles with shortages.

In this light, planning is to be understood as a complementary process of *anticipatory* regulation that coordinates immediate and future economic action. Its function is to facilitate the formulation of feasible collective goals by taking into account their anticipated requirements and steering the behaviour of enterprises towards an efficient use of resources to meet these goals.²⁷ Such large-scale economic coordination, however, raises a set of mutually reinforcing problems of *information* and *incentives* that became apparent as the Soviet-type planning institutions emerged.

Soviet-Type Planning – Prospects and Problems

Socialists were first forced to confront the challenges of planning in the destructive context of wartime mobilization, especially where they seized power in Russia and parts of Germany. The First World War not only altered the coordinates of socialist politics, it profoundly shaped socialist economic theory. Specifically, the wartime economy of imperial Germany provided a model for Lenin.²⁸ After devastating wars, Soviet planning institutions emerged from the needs of industrial development, starting with the electrification of a large agrarian country.

While the Soviet political structure limited democratic deliberation and contestation over plan goals, its form of planning was far from an unmitigated disaster, contrary to current liberal ideology. In the 1920s, Soviet economists were opening new frontiers of research by making rapid advances in e.g. methods of national accounts and the theories of economic growth and investment – until they were stifled by the political culture under Stalin. While no major capitalist market economy could escape the devastation of the Great Depression, the Soviet economy exhibited an extraordinary expansion of output and investment during this period. Between 1928 to 1940, it achieved a scale of industrial transformation that had taken several decades to achieve in other countries. As a consequence, its people experienced a dramatic transformation of their livelihoods and living standards.²⁹ While first improvised out of necessity, planning had become a decisive factor by the Second World War. The Soviet economy could mobilize its production more rapidly than its mortal enemy, despite starting off from a much weaker

²⁵To use some examples cited in Ackerman (2026).

²⁶This is a consequence of the internal model principle discovered by control theorists. See Isidori (2025).

²⁷That is, it focuses on feedforward control by anticipating economy-wide effects of future goals. This is to complement the feedback control in autonomous regulation, see Matni et al. (2024).

²⁸Smolinski (1969).

²⁹See Gregory and Saylor (2003) and Allen (2003).

industrial base.³⁰ Even capitalist states of the United States and United Kingdom suspended market coordination and installed comprehensive planning institutions for the war effort. Well into the 1950s, it was feared among Western elites that the USSR would overtake the US. Its exceptional economic modernization process certainly bolstered the appeal of using planning techniques in the post-war reconstruction of France, the Netherlands, and Japan as well as parts of post-independence Africa, Asia, and South America.

Soviet-type planning involved three institutional layers: central planning authorities, industrial/regional ministries, and individual enterprises. Long-term development goals were politically determined by the center and operationalized as annual production *targets* for a wide range of products. These were arrived at through an iterative process of *material supply balancing*.³¹ Each year, the center would announce aggregate targets, after which the enterprises responded with their estimated quantities of inputs required to meet these initial targets. The center and ministries would then attempt to balance the internal supply and demand figures until settling on the official production targets. The fulfillment of these targets was one of several economic criteria used to *evaluate* enterprises. While capable of rapid industrialization, the planning system was also riddled with persistent problems of rigidities, inefficiencies, product quality and shortages, which were only partially compensated by horizontal coordination within gray and black markets.³² Some problems were of course historically specific, such as those arising from the enormous diversion of resources towards military defense through both hot and cold wars. But fundamentally there were mutually reinforcing problems of *information* and *incentives* that arise in large economic organizations.³³

Firstly, the *downstream* information was inadequate. While the balancing method was a rather ingenious innovation for coordinating production under severe informational limits, it could not arrive at consistent plans in which the internal resource requirements and supplies would balance to meet the intended targets. The annual procedure was not responsive enough to efficiently adapt to rapidly changing conditions. Moreover, it reinforced structural rigidities by setting growth-driven targets not only for final products but also those used up in production. Importantly, its costing methods provided no reliable means of evaluating how different economic alternatives put internal resources to use in achieving plan goals.³⁴

Secondly, the *upstream* information was both inaccurate and incomplete. The vast number of diverse products used at the enterprise layer had to be crudely aggregated into a few thousand types to eventually be processed at the center layer. This masked information about efficient or wasteful practices at the lower layers. The procedure also had few means of eliciting timely and local information about production options, technical problems, quality grades or sudden opportunities which could improve the feasibility or efficiency of the plans. The pooling of such information at the center was necessarily partial.³⁵

Thirdly, the *alignment* of interests between the policy makers at the center layer and the decision makers at lower layers failed. On the one hand, the central plans determined both the output expected from the enterprises and the resources allocated to them. On the other hand, the center depended on information provided by the *very same* enterprises to arrive at the plans in the

³⁰Harrison (2000).

³¹Montias (1959) and Manove (1971) provide a characterization of the method of material balances.

³²There is a vast literature on the problems of Soviet-type economies. For an overview, see for instance Dobb (1970), Nove (1986, 1991, 1992), Ellman (1973, 1978, 2014), Kornai (1980), Dyker (1985), Gregory (1990), Eatwell et al. (1990), Ericson (1991) and Allen (2003).

³³Information and incentive problems became an active research program following the so-called socialist calculation debates. See, for instance, Hurwicz (1973) and Radner (1987).

³⁴In the 1920s debate against Neurath, von Mises correctly predicted that the lack of an appropriate costing metric would result in the squandering of resources under planning.

³⁵This was a key argument in Hayek (1945).

first place.³⁶ The incentives therefore drove enterprises and ministries to understate production possibilities and report exaggerated output data so as to moderate and meet central targets. At the same time, enterprises facing uncertainties in the supply allocation found it rational to report inflated input requirements and hoard resources in order to secure their production. Wasteful enterprises lacked an effective budget constraint, since the center was reluctant to wind them down. Overall demand for inputs and investment goods could then easily outpace the growth of supplies, thereby cementing persistent shortages. The process of formulating consistent plans was also undermined by opaque negotiations with sectoral groups that bargained for their local interests.³⁷

A series of reform efforts aimed at addressing several of the above challenges led to mixed results. Improved computerized planning methods were pioneered in Hungary by the late 1950s and found later success in a few areas, such as production scheduling and investment allocations. However, there were both technological limits to process the requisite economic data and institutional limits to elicit reliable information in the first place. By the end of the 1960s, the leading Soviet mathematical economist Viktor Novozhilov concluded that the institutional information and incentive problems held back growth more than could ever be realized by adopting mathematically superior planning methods.³⁸

Institutional reforms were pioneered in Yugoslavia, which had achieved a high degree of political independence from the USSR due the role of its domestic forces in defeating fascist occupation. In 1950, it rejected Soviet-type planning in favor of a system of self-managed enterprises. However, it unleashed some of the highest unemployment levels in Europe and cemented deep regional inequalities. More dramatically, the market-based reforms introduced under Gorbachev wrecked the planning mechanisms of the USSR and sent it into terminal decline. Both cases ended with disastrous social consequences. On the other hand, Hungary, where substantial elements of decentralised mechanisms were introduced, fared far better. Together with the developed economies of Czechoslovakia and East Germany, they continued to improve material living standards, but could never close the gap to their European neighbors. The persistent gaps undermined the political feasibility of these economies. It is indicative that when East Germans were polled four years after unification about their new economic conditions, they responded overwhelmingly that commodity and leisure supplies were superior under welfare-state capitalism.³⁹

None of the reform efforts succeeded in resolving or offsetting the fundamental problems of information and incentives in Soviet-type planning. Even if it could use later advances in information technologies to tackle some of the information problems, they could not overcome the institutional problems. The ruptural paths through which communist parties seized and monopolized power for their survival led to resistance against institutional innovations that implied relinquishing control. Furthermore, lacking feasible technological alternatives, the established planning process required a bureaucratic apparatus to operate, which concentrated economic power in the planning agencies who were also unwilling to give it up. In the USSR, the system had after all delivered a dramatic economic transformation and defeated an industrial war machine, which only cemented conservatism against fundamental institutional changes.

³⁶In the economics literature, this is referred to as a ‘principal-agent problem’, see e.g. Gregory (1990), Harrison (2005).

³⁷See for instance Köhegyi and Kovács (2022).

³⁸Cited in Ellman (1973, p. 40). See also Novozhilov (1970). Together with Kantorovich and Nemchinov, Novozhilov was instrumental in reviving mathematical economics in the USSR after the death of Stalin.

³⁹Poll by Institut für Demoskopie Allensbach (Spring 1994) cited in Therborn (1995). The poll also revealed that the same East Germans overwhelmingly thought that safety, child rearing, the supply of interesting jobs and the sense of community, were superior in their former economy despite its deficiencies.

Anticipatory Regulation – Instruments and Mechanisms

Tackling the problems of information and incentives requires a different starting point than the war economies of the early twentieth century. In our view, it should be the autonomous regulation of production by enterprises – whether they organize power plants, steel mills or hospitals. For them, *plan goals* are operationalized as contractually committed *final orders* on their future outputs, registered under investment and provision projects, and collective *resource constraints* stipulated by the viability assembly. Enterprises respond to these goals by autonomously placing their *internal orders* to maintain inventories and production (see Figure 1).

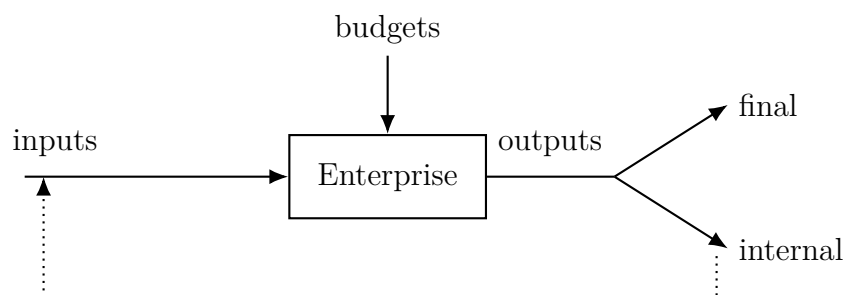


Figure 1: Enterprise in the planned sector, where final and internal orders are placed on its outputs under projects and by other enterprises, respectively.

A complementary process of *anticipatory regulation* should take into account overall resource requirements and constraints to continually enable feasible plan goals while steering the allocations for enterprises to reach them efficiently. We can think of it as an analogy to the computer-aided management of an airline fleet. It plans routes for a large number of aircraft so as to continually meet connected transportation goals in a fuel-efficient manner. Yet each aircraft operates autonomously, adapting to its local information and conditions which may require fleet management to continually draw up new routes to follow.

The central concern here is that if enterprises can mask the squander or hoarding of collective resources, *they prevent collective goals from being satisfied*. To tackle the information and incentive problems, we propose a form of anticipatory regulation using three computer-aided instruments as downstream information⁴⁰:

- *Shadow pricing* of resources that adapts to varying opportunity costs and uncertainties of production.
- Allocation of *budgets* that constrain the degrees of freedom to utilize collective resources.
- Quantitative *balancing* of final demand and collective resource constraints so that they are jointly feasible with high probability.

In contrast to Soviet-type planning, these instruments do not use any explicit production targets nor reward enterprises based on how well they reach such targets. The instruments are also implemented through *rolling* plans, which were proposed by planning theorists already in the late-1930s as a means to tackle the inherent uncertainties in anticipated outcomes.⁴¹ That is, a sequence of overlapping plan horizons (see Figure 2), where goals are articulated as final orders and resource constraints. Importantly, for each plan, the goals are *incremental* in relation to those settled in the previous overlapping plan horizon. Thus an anticipatory coordination of resources can continually adapt to changing circumstances as new information becomes available,

⁴⁰See Johansen (1977, 1978) and Chander and Parikh (1990) for an overview of planning instruments and mechanisms.

⁴¹See Svernilson (1965) and Lundberg (1972).

while leaving the autonomous regulation by enterprises intact to react to local opportunities and unforeseen changes.⁴²

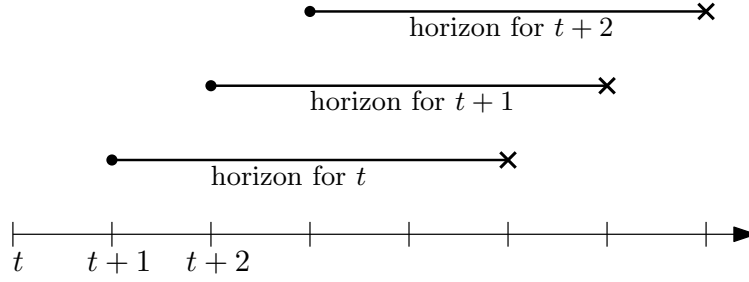


Figure 2: Example of rolling plan at each month with a horizon of four months. Each plan horizon concerns incremental goals in the light of previously settled plan goals and revealed outcomes.

We propose a monthly rolling planning procedure overseen by a public coordination agency that can be outlined as follows:

1. *Shadow prices* of resources are announced for the new plan horizon of, say, twenty months.
2. The *budget for final orders* over this horizon is divided between the sectoral boards for investment and provision in accordance with the elected economic program.
3. The final orders and resource constraints are *balanced*, taking into account internal resource usages by enterprises.
4. Enterprises receive *budget allocations* with which they can employ labor and place new internal orders they deem necessary.
5. As the orders are placed, the plan horizon is *settled*, and a subsequent one begins in the next month.

For the remainder of this section we elaborate on how the above steps are operationalized and analyze how they address the problems of information and incentives.

Shadow prices of resources

The key information used for anticipatory regulation is elicited in the very process of autonomous regulation, where the enterprises' orders and inventories are managed electronically as in present-day procurement and inventory systems. Specifically, their orders, employment of labor and inventory changes are stored in a public database. At the beginning of each month, the enterprise-level data from the *previously* settled plan horizon is summarized on a monthly basis and constitutes the anticipated supply and use of resources across the planned sector. From this upstream information, we derive *opportunity costs* to be used in the subsequent plan horizon.

Our approach generalizes the work that Novozhilov began developing in the 1940s.⁴³ Both from a normative and economic standpoint, the enterprises must not squander the finite human labor time of society. Labor is the *ultimate* production input, since it can be mobilized to produce, say, power or steel plants, but the latter cannot be mobilized to increase the amount of available labor. Thus we take the use of labor time as a *cost of economic opportunity* and derive corresponding *shadow prices* of the resources used and produced.

For sake of illustration, consider two collective goals for a *future* month that were settled in the *previous* plan horizon. One is a resource constraint of 600 kilotonnes of crude oil imports and

⁴²Thus an appropriately layered process of autonomous and anticipatory regulation will not induce 'schedule instability' as claimed by Ackerman (2026), see Matni et al. (2024).

⁴³See Novozhilov (1970).

the other is a final order of 300 GWh of electrical power. The crude oil limit is expressed as an inequality:

$$600 \geq 50 + 70 + 100 + \dots,$$

where the right-hand side is the sum of crude oil ordered internally by enterprises producing fuel, pharmaceutical feedstock, and so on. The electric power ordered through provision projects is similarly expressed as an inequality:

$$300 \leq 500 + 100 - 10 - 20 - \dots,$$

where the right-hand side sums the ordered production by two power plants and subtracts the power consumption ordered by other enterprises. By comparing ex-ante orders and ex-post outcomes in the past, deviations in the anticipated data can be tracked for each enterprise. For instance, a power plant may have delivered output with a 5% shortfall, or an aluminium smelter may have used 3% more power than its ex-ante consumption, and so on. We can now define opportunity costs by posing the following question: What is the *minimal* amount of labor required to satisfy the above inequalities with high probability, when taking into account the least favourable deviations in enterprises' anticipated data?

It turns out that this *counterfactual labor-saving problem* using uncertain data can be posed as a so-called linear program. Its solution produces opportunity costs in the form of so-called *shadow prices* – which are the estimated marginal labor costs of the resources.⁴⁴ For limited resources, the shadow price per kilotonne of imported crude oil is the amount of worker-hours that could be *saved* by increasing the imports by one unit. For final orders, the shadow price per GWh of electrical power supply is the *additional* amount of worker-hours required to increase the order by one unit. Note that the shadow prices of, say, local water from a limited fresh water supply will vary over the plan horizon depending on how its scarcity impinges on the productive capacity of the planned sector as a whole. Moreover, outputs which can be produced *reliably* will, all else equal, receive *lower* shadow prices since they require less labor to compensate for potential deviations from the ex-ante orders.

In practice, computing shadow prices for the planned sector would involve several millions of inequalities and enterprise orders. Such large-scale sparse linear programs have been actively researched for decades and recent methods can solve problems involving up to one billion variables to suitable accuracy within twenty hours using commercially available hardware.⁴⁵

Thus a public coordination agency provides a list of shadow prices of collective resources, in units of worker-time, for use in the *new* plan horizon. The shadow price budgets allocated to sectoral boards and enterprises in the new plan represent their requisitioning power over these resources, denominated in units of worker-time.

Balancing of collective goals

In the example above, the *previous* plan settled on a constraint of 600 kilotonnes of crude oil imports for a future month. These were set via goals stipulated by the viability assembly. For incremental goals in the *new* plan horizon, conditions may allow for, say, an *additional* 30

⁴⁴The shadow prices are dual variables of a convex optimization problem, see Bertsimas and Sim (2004) for a formal treatment. This approach automatically builds in adaptable slack and minimizes problems of ‘taut’ plans that plagued the Soviet-type economies. Moreover, since each enterprise uses only a small subset of possible inputs to produce a small set of outputs, the resulting large-scale linear program is sparse and therefore highly scalable.

⁴⁵Thus runtimes of “a thousand years” cited by Sunkara et al. (2025) are not grounded in research on sparse linear programs. See Luenberger and Ye (2021) and Applegate et al. (2026).

kilotonnes in that same month. Using the shadow prices of the limited resources, a budget for final demand can now be formed as:

$$\text{Final demand budget} = \text{Labor-time available} + \text{Shadow price of resource constraints},$$

based on the employable labor available at the enterprises. This budget is allocated to the sectoral boards in proportions stipulated by the elected economic plan. It will therefore constrain any final demand for, say, electrical power and insulin. Before final orders can be settled with the enterprises along with resource constraints, both must be rendered jointly feasible with high probability. This can be posed as a *goal-balancing problem* using the enterprises' supply and use data from the corresponding months in the previously settled plan. It is solved similarly to the counterfactual labor-saving problem above.

Suppose incremental plan goals include, say, 10 GWh electricity and 30 kilotonnes of imported oil. If they are found jointly feasible in the goal-balancing solution, then final orders are placed with the enterprises as is. On the other hand, if these goals conflict, then the resource constraints and the final demand are rebalanced, such that the sum of percentage deviations from the goals (10 GWh, 30 kilotonnes, and so on) is *minimized*. By solving this goal-balancing problem as another sparse linear program, we arrive at a set of final orders and resource constraints that are jointly feasible with high probability.

When taking into account internal supply and use of resources, the solution may conclude that only 9 GWh of power and 31 kilotonnes of oil are feasible. Then the final order could be placed accordingly. But if the trade-off between aggregate oil imports and power for final consumption urgently needs adjustment, it can be negotiated between the sectoral boards and the viability assembly where the ultimate decision power rests with the latter. The goal-balancing method thereby forms a bridge between the limited perceptive capacities of decision-makers at the sectoral boards and the vast complexities of joint production across the planned sector. It enables the exploration of production possibilities; the explanation of interdependencies between conflicting goals; and the improvement in efficiency.⁴⁶

Enterprise budgets and alignment of interests

The goal-balancing solution also produces an important by-product: a robust estimate of incremental labor and non-labor requirements for each enterprise across the new plan horizon. We propose a corresponding *allocation of operational budgets* towards enterprises. Suppose for a given month, the estimated labor requirements for a steel mill are 100 worker-hours and the shadow prices of the non-labor requirements are 200 worker-hours. Then it can autonomously employ additional labor and place internal orders within the allocated labor budget of 100 worker-hours and non-labor budget of 200 worker-hours, respectively. All else being equal, the goal-balancing solution will allocate larger budgets to enterprises whose outputs are in demand and that contribute to make the plan goals maximally feasible. The allocation of enterprise budgets *shapes their incentives* to elicit accurate information and produce in accordance with collective goals. We therefore consider how the budget allocation mechanism aligns their interests.⁴⁷

With an allocated labor budget, an enterprise may increase employment of labor but it does *not* pay for its remuneration out of any revenue. Instead, its workers receive monetary remuneration

⁴⁶Paraphrasing Kornai (1970), who was deeply involved in trying to improve the planning system in Hungary. In certain respects, the goal-balancing method realizes Neurath's vision of planning in physical quantities, albeit only at a certain stage in the planning procedure. It also avoids the economically rather unmotivated objective function initially proposed by Kantorovich – repeated also in Vettese and Pendergrass (2022) and Cockshott et al. (2022) – in which final outputs are evaluated in fixed proportions, see Barden (1975).

⁴⁷Analysis of incentive compatibilities is rather uncommon among socialist proponents of planning, see Laibman (2011) for an exception.

for the effort, which they can choose to spend in the market sector, from a sovereign labor fund managed by *sectoral labor boards*. Their effort is a human *cost* that requires compensation as a necessary, albeit insufficient, component of worker motivation on a mass scale. The role of the sectoral labor boards is to facilitate the mobilization of labor to realize investment and provision projects. Labor *shortages* inevitably constrain the capacity of the planned sector, since the transfer and training of workers can never exactly match the changing demand for various labor skills. Even if shortages in, say, mines or hospitals could be overcome by training, work reorganization or automation, it would not solve the problem in the *short run*. Thus *differentials* in work compensation, both vacation time and remuneration are indispensable measures to address labor shortages in the short run. The sectoral labor boards credit work performed in the enterprises at varying rates of remuneration from a labor fund that is fundamentally limited by the constraint to maintain consumer price inflation and a balance of payments within limits set by the viability assembly.⁴⁸ The politically acceptable levels of compensation differentials and shortages is a trade off to be periodically renegotiated through these sectoral boards, which have worker representatives to defend their interests.⁴⁹ In sum, the workers have an interest in maximizing the labor budget allocation for their enterprise, but only to secure employment time rather than the actual compensation.

In the interest of remaining operational, enterprises similarly prefer larger labor and non-labor budget allocations. Suppose an enterprise uses its budgets to employ more labor or hoard resources, yet has not received increased orders. The effect of such increased resource usage is an *increase* in the shadow prices of the enterprise's products. All else equal, this would diminish incoming orders from projects or other enterprises – and therefore *reduce* its subsequent budget allocations. On the other hand, running down inventories and buffer capacities would be counterproductive because any resulting shortfall delivering on orders would *also* result in increased shadow prices, which take into account the additional labor to compensate for possible deviations. We conclude that shadow prices, and budget allocations based on a goal-balancing solution, incentivize enterprises to utilize collective resources *efficiently* to meet their individual orders *reliably*.

The *degree* of interest alignment depends on whether the enterprise's outputs are substitutable and whether they can be produced by other enterprises. These situations are summarized in Table 1.

	Multiple enterprises	Single enterprise
Substitutable outputs	A	B
Nonsubstitutable outputs	C	D

Table 1: Outputs produced by multiple enterprises or a single enterprise, classified by their substitutability.

In cases A and B, when an output is highly substitutable for alternatives, a change in its shadow price has a significant impact on demand. This would reinforce a high degree of interest alignment. On the other hand, in cases C and D, with less substitutable outputs such as electrical power, changes in the shadow price have weaker effects on demand in the short run. This indeed would be a rather common situation, since the planned sector is focused on essential and vital products. However in C, with, say, multiple power suppliers, the goal-balancing solution would allocate budgets in accordance with how each supplier contributes to making the final demand

⁴⁸The size of the labor fund is therefore constrained by the level of taxation and sales of essential products to the market sector.

⁴⁹This would make negotiations not too unlike the peaks of sectoral bargaining in countries like Sweden and Norway. The viability assembly could possibly define limits on the differentials as well, but their political salience will depend on the basic needs secured through public provision.

and resource constraints jointly feasible. This would again align their interests towards resource efficiency. The main case for concern is therefore D. That is, when there is only a single cement or insulin producer. If left unchecked, such an enterprise could squander labor and hoard resources. It is therefore advisable to assign the sectoral investment boards the task of investing in parallel capacities for cement or insulin production to steer away from case D in the planned sector.

In summary, the budget allocation mechanism generates an imperative to receive budget allocations with which an enterprise can find and meet demand for its outputs in a resource efficient and reliable manner. This incentivizes *dynamic efficiency* both through the refinement of existing production methods as well as the innovation of new useful outputs. The process is compatible with competitive, as well as cooperative, interactions between enterprises.

Renewing or expanding an enterprise's productive assets – such as new machinery or buildings – may require far more resources than a non-labor budget can afford. For instance, a concrete producer may not be able to place an order on an investment good such as a new custom silo. An enterprise can then submit proposals for a budgeted project to sectoral investment boards. Unlike banks, the boards do not evaluate any rates of return, but they can benchmark the benefits of a project proposal against its expected opportunity costs, denominated in units of worker-time. For instance, a proposal for a custom cement silo would require specifying its estimated costs of construction as well as a maintenance schedule over its operational life. This means proposals are budgeted by the amount of labor they tie down over this period. The labor for maintaining and repairing investment goods is covered by a granted project, which the board periodically reviews and can choose to renew or terminate.

Enterprises can therefore be wound down in the planned sector either by steadily diminishing budget allocations, due to lack of demand or efficiency, or by non-renewed investment projects. While their workers risk losing their employment, they do not risk losing their livelihood due to market dependence.

Conclusion

We have argued that market allocation, with or without labor-managed firms, lacks the information and capacity to address the economic problems of climate change, geopolitical conflict and demographic decline. This motivates restoring planning at the *center* of socialist economics as a means of securing the material well-being of a population under resource limits.⁵⁰ Specifically, the planned sector should be concerned with the provision of essential and vital products. This *asymmetric productive power* erodes market dependence and enables it to regulate a rather substantial market sector concerned with individual consumption. We propose that overall plan goals are determined democratically by a viability assembly and through the election of economic programs, which specify budget allocations for sectoral investments and provision. Corresponding boards then grant budgeted projects for housing, transportation, rewilding, and so on, which involve final orders with a large number of enterprises.

Large-scale economic coordination, however, raises a set of mutually reinforcing *problems of information and incentives* that become apparent in the Soviet-type economies. These hinder the formulation of feasible plan goals and undermine the means of reaching them. We ground our approach in the *autonomous* regulation of production by enterprises. In the short run, this regulation is informationally inexpensive and resilient against random shocks. We propose a rolling planning procedure to continually formulate feasible plan goals and steer the enterprises towards reaching them by leveraging the information exchanged electronically in autonomous

⁵⁰Research into questions about planning is being pursued within the recently formed International Network for Democratic Economic Planning (INDEP), see <https://www.indep.network/>. It is a research program that requires committed economists and engineers.

regulation. Specifically, the procedure uses three instruments: shadow pricing of resources; allocation of budgets; and quantitative balancing of final demand and resource constraints. This results in a complementary form of *anticipatory* regulation and we outlined how it aligns the interests of the enterprises towards dynamic efficiency.

With this contribution, we hope to spark a debate among socialist economists. Not another one about the virtues and vices of markets versus plans, but rather *how* planning should operate in a socialist economy that enables the *flourishing* of individual and collective life *within* our planetary boundaries.

References

- Seth Ackerman. Socialism Can Work. Cybersocialism Can't. Forthcoming, 2026.
- Michael Albert and Robin Hahnel. *The Political Economy of Participatory Economics*. Princeton University Press, Princeton, NJ, 1991. doi: 10.1515/9780691216003.
- Robert C. Allen. *Farm to Factory: A Reinterpretation of the Soviet Industrial Revolution*. Princeton University Press, Princeton, NJ, 2003.
- David Applegate, Mateo Díaz, Oliver Hinder, Haihao Lu, Miles Lubin, Brendan O'Donoghue, and Warren Schudy. PDLP: A practical first-order method for large-scale linear programming. *Mathematical Programming Computation*, 2026. doi: 10.1007/s12532-026-00309-2.
- Drew S. Barden. Optimal planning: A radical critique. *Review of Radical Political Economics*, 7(4):33–47, 1975. doi: 10.1177/048661347500700403.
- Mike Beggs. The market and workplace in a democratic socialism. *Catalyst*, 6(3), 2022. URL <https://catalyst-journal.com/2023/01/the-market-and-workplace-in-a-democratic-socialism>.
- Aaron Benanav. Beyond capitalism—1. *New Left Review*, (153), 2025a. URL <https://newleftreview.org/issues/ii153/articles/aaron-benanav-beyond-capitalism-1>.
- Aaron Benanav. Beyond capitalism—2. *New Left Review*, (154), 2025b. URL <https://newleftreview.org/issues/ii154/articles/aaron-benanav-beyond-capitalism-2>.
- Dimitris Bertsimas and Melvyn Sim. The price of robustness. *Operations Research*, 52(1):35–53, 2004. doi: 10.1287/opre.1030.0065.
- John Burnheim. *Is Democracy Possible? The Alternative to Electoral Politics*. Polity Press, Cambridge, 1985.
- Parkash Chander and Kirit S. Parikh. Theory and practice of decentralized planning procedures. *Journal of Economic Surveys*, 4(1):19–58, 1990. doi: 10.1111/j.1467-6419.1990.tb00078.x.
- W. Paul Cockshott and Allin F. Cottrell. *Towards a New Socialism*. Spokesman, Nottingham, UK, 1993. URL https://users.wfu.edu/cottrell/socialism_book/.
- W. Paul Cockshott and David Zachariah. Hunting productive work. *Science & Society*, 70(4):509–527, 2006.
- W. Paul Cockshott, Allin Cottrell, and J. Philipp Daprich. *Economic Planning in an Age of Climate Crisis*. Independently published, 2022. ISBN 9798360125563. URL <https://westminsterresearch.westminster.ac.uk/item/x07v6/economic-planning-in-an-age-of-climate-crisis>.
- G. A. Cohen. *Why Not Socialism?* Princeton University Press, Princeton, NJ, 2009.
- Pat Devine. *Democracy and Economic Planning: The Political Economy of a Self-Governing Society*. Polity Press, Cambridge, UK, 1988.
- Maurice Dobb. *Socialist Planning: Some Problems*. Number 12 in Socialism Today. Lawrence & Wishart, London, 1970.
- David A. Dyker. *The Future of the Soviet Economic Planning System*. Croom Helm, London, 1985.
- John Eatwell, Murray Milgate, and Peter Newman, editors. *Problems of the Planned Economy*. The New Palgrave. Palgrave Macmillan, London, 1990.
- Michael Ellman. *Planning Problems in the USSR: The Contribution of Mathematical Economics to their Solution 1960–1971*. Cambridge University Press, Cambridge, 1973.

- Michael Ellman. The fundamental problem of socialist planning. *Oxford Economic Papers*, 30(2):249–262, 1978.
- Michael Ellman. *Socialist Planning*. Cambridge University Press, Cambridge, 3rd edition, 2014.
- Richard E. Ericson. The classical Soviet-Type economy: Nature of the system and implications for reform. *Journal of Economic Perspectives*, 5(4):11–27, 1991. doi: 10.1257/jep.5.4.11.
- Sam Gindin. Socialism for realists. *Catalyst: A Journal of Theory and Strategy*, 2(3), 2018. URL <https://catalyst-journal.com/2018/12/socialism-for-realists>.
- Paul R. Gregory. The Stalinist command economy. *The ANNALS of the American Academy of Political and Social Science*, 507(1):18–25, 1990. doi: 10.1177/0002716290507001002.
- Paul R. Gregory and Joel Sailors. The Soviet Union during the Great Depression: The autarky model. In Theo Balderston, editor, *The World Economy and National Economies in the Interwar Slump*, pages 191–210. Palgrave Macmillan, Basingstoke, 2003.
- Gregory Grossman. Notes for a theory of the command economy. *Soviet Studies*, 15(2):101–123, 1963. doi: 10.1080/09668136308410352.
- Max Grünberg. Automating away the centre? optimal planning and the menace of bureaucratisation. *Competition & Change*, 29(1):38–63, 2025. doi: 10.1177/10245294231218868.
- Simon Hannah. *Reclaiming the Future: A Beginner’s Guide to Planning the Economy*. Pluto Press, London, 2024. ISBN 9780745350202.
- Mark Harrison. Industrial mobilisation for World War II: A German comparison. In John Barber and Mark Harrison, editors, *The Soviet Defence Industry Complex from Stalin to Khrushchev*, pages 99–117. Macmillan Press, Basingstoke, 2000.
- Mark Harrison. The fundamental problem of command: Plan and compliance in a partially centralised economy. *Comparative Economic Studies*, 47(2):296–314, 2005. doi: 10.1057/palgrave.ces.8100110.
- Friedrich A. Hayek. The use of knowledge in society. *American Economic Review*, 35(4):519–530, 1945.
- Jason Hickel and Dylan Sullivan. How much growth is required to achieve good lives for all? insights from needs-based analysis. *World Development Perspectives*, 35:100612, 2024. doi: 10.1016/j.wdp.2024.100612.
- Leonid Hurwicz. The design of mechanisms for resource allocation. *American Economic Review*, 63(2): 1–30, 1973.
- Alberto Isidori. The internal model principle – the seminal contributions of Francis and Wonham. *IEEE Control Systems Magazine*, 2025. Exact volume/issue/page numbers and DOI not independently verified.
- Leif Johansen. *Lectures on Macroeconomic Planning, Part 1: General Aspects*. North-Holland, Amsterdam, 1977.
- Leif Johansen. *Lectures on Macroeconomic Planning, Part 2: Centralization, Decentralization, Planning under Uncertainty*. North-Holland, Amsterdam, 1978.
- Gergely Köhegyi and János Mátyás Kovács. Mathematical economics outside the neoclassical paradigm? evolution of planning concepts in Hungary under communism. In János Mátyás Kovács, editor, *Communist Planning versus Rationality: Mathematical Economics and the Central Plan in Eastern Europe and China*, pages 145–210. Lexington Books, 2022.
- János Kornai. A general descriptive model of planning processes. *Economics of Planning*, 10(1):1–18, 1970. doi: 10.1007/BF00347043.
- János Kornai. *Economics of Shortage*. North-Holland, Amsterdam, 1980.
- János Kornai and Béla Martos. Autonomous control of the economic system. *Econometrica*, 41(3): 509–528, 1973.
- János Kornai and Béla Martos, editors. *Non-Price Control*. Number 133 in Contributions to Economic Analysis. North-Holland, Amsterdam, 1981.
- Maximilian Kotz, Anders Levermann, and Leonie Wenz. The economic commitment of climate change. *Nature*, 628(8008):551–557, 2024. doi: 10.1038/s41586-024-07219-0.
- David Laibman. Incentive design, iterative planning and local knowledge in a maturing socialist economy. *International Critical Thought*, 1(1):1–22, 2011. doi: 10.1080/21598282.2011.566039.
- Oskar Lange. The role of planning in socialist economy. *Indian Economic Review*, 4(2):1–15, 1958.

- Frédéric Legault and Simon Tremblay-Pepin. A brief sketch of three models of democratic economic planning. Technical Report 2, Élisabeth-Bruyère School of Social Innovation, Saint Paul University, 2021. URL <https://innovationsocialeusp.ca/wp-content/uploads/2021/04/Note-2-Legault-and-Tremblay-Pepin-Democratic-Planning.pdf>.
- David G. Luenberger and Yinyu Ye. *Linear and Nonlinear Programming*, volume 228 of *International Series in Operations Research & Management Science*. Springer, Cham, 5th edition, 2021. doi: 10.1007/978-3-030-85450-8.
- Erik Lundberg. Ingvar Svennilson: A note on his scientific achievements and a bibliography of his contributions to economics. *The Swedish Journal of Economics*, 74(3):313–328, 1972.
- Andreas Malm. *How to Blow Up a Pipeline: Learning to Fight in a World on Fire*. Verso, London, 2021.
- Michael Manove. A model of Soviet-Type economic planning. *American Economic Review*, 61(3):390–401, 1971.
- Béla Martos. Control and coordination of economic activity. In John Eatwell, Murray Milgate, and Peter Newman, editors, *Problems of the Planned Economy*, The New Palgrave. Palgrave Macmillan, London, 1990. doi: 10.1007/978-1-349-20863-0_9.
- Nikolai Matni, Aaron D. Ames, and John C. Doyle. A quantitative framework for layered multirate control: Toward a theory of control architecture. *IEEE Control Systems Magazine*, 44(3):52–94, 2024. doi: 10.1109/MCS.2024.3382388.
- John Michael Montias. Planning with material balances in Soviet-Type economies. *American Economic Review*, 49(5):963–985, 1959.
- Otto Neurath. *Durch die Kriegswirtschaft zur Naturalwirtschaft*. Georg D. W. Callwey, Munich, 1919.
- Alec Nove. *The Soviet Economic System*. Unwin Hyman, London, 3rd edition, 1986.
- Alec Nove. *The Economics of Feasible Socialism Revisited*. Routledge, London, 2nd edition, 1991.
- Alec Nove. *An Economic History of the USSR, 1917–1991*. Penguin Books, London, 3rd edition, 1992.
- Viktor V. Novozhilov. *Problems of Cost-Benefit Analysis in Optimal Planning*. International Arts and Sciences Press, White Plains, NY, 1970. Translation of the 1967 Russian original.
- Leigh Phillips and Michal Rozworski. *The People’s Republic of Walmart: How the World’s Biggest Corporations are Laying the Foundation for Socialism*. Verso, London, 2019.
- Adam Przeworski. *Capitalism and Social Democracy*. Studies in Marxism and Social Theory. Cambridge University Press, Cambridge, 1985.
- Roy Radner. Decentralization and incentives. In Theodore Groves, Roy Radner, and Stanley Reiter, editors, *Information, Incentives, and Economic Mechanisms*, pages 3–47. University of Minnesota Press, Minneapolis, MN, 1987.
- John E. Roemer. *A Future for Socialism*. Harvard University Press, Cambridge, MA, 1994.
- John E. Roemer. Socialism revised. *Philosophy & Public Affairs*, 45(3):261–315, 2017. doi: 10.1111/papa.12089.
- David Schweickart. *After Capitalism*. Rowman & Littlefield, Lanham, MD, 2002.
- David Schweickart. Nonsense on stilts: Michael Albert’s Parecon, 2006. URL <http://dschwei.sites.luc.edu/parecon.pdf>.
- Herbert A. Simon. On the application of servomechanism theory in the study of production control. *Econometrica*, 20(2):247–268, 1952.
- Leon Smolinski. Lenin and economic planning. *Studies in Comparative Communism*, 2:96–114, 1969. doi: 10.1016/S0039-3592(69)80005-0.
- Piero Sraffa. *Production of Commodities by Means of Commodities: Prelude to a Critique of Economic Theory*. Cambridge University Press, Cambridge, 1960.
- Sergey Steblev and Giorgos Kallis. Economic planning in theories of socialism: The concept, motivations, and ‘autonomous control’ as a socialist invisible hand. Paper presented at “Economic Planning in the Anthropocene” workshop, University of Geneva, 24–26 September 2025, 2025. URL <https://agenda.unige.ch/attachments/download/19319>.
- Bhaskar Sunkara, Mike Beggs, and Ben Burgis. The plans that failed. *Catalyst*, 9(2-3), 2025. URL <https://catalyst-journal.com/2025/12/the-plans-that-failed>.

- Ingvar Svennilson. Planning in a market economy. *Weltwirtschaftliches Archiv*, 95, 1965. URL <https://www.jstor.org/stable/40436352>.
- Göran Therborn. *European Modernity and Beyond: The Trajectory of European Societies, 1945–2000*. Sage, London, 1995.
- Thomas E. Uebel. Incommensurability, ecology, and planning: Neurath in the socialist calculation debate, 1919–1928. *History of Political Economy*, 37(2):309–342, 2005. doi: 10.1215/00182702-37-2-309.
- Adaner Usmani. Democracy and the class struggle. *American Journal of Sociology*, 124(3):664–704, 2018. doi: 10.1086/700235.
- David Van Reybrouck. *Against Elections: The Case for Democracy*. The Bodley Head, London, 2016. Translated by Liz Waters.
- Troy Vettese and Drew Pendergrass. *Half-Earth Socialism: A Plan to Save the Future from Extinction, Climate Change and Pandemics*. Verso, London, 2022.
- Nicholas Vrousalis. Socialism unrevised: A reply to Roemer on Marx, exploitation, solidarity, worker control. *Philosophy & Public Affairs*, 49(1):78–109, 2021. doi: 10.1111/papa.12183. Cited in draft as “(2020)”; journal issue confirmed as Winter 2021.
- Martin L. Weitzman. Prices vs. quantities. *The Review of Economic Studies*, 41(4):477–491, 1974. doi: 10.2307/2296698.
- Norbert Wiener. *Cybernetics: Or Control and Communication in the Animal and the Machine*. MIT Press / John Wiley & Sons, Cambridge, MA / New York, 1948.
- David Zachariah and Paul Cockshott. Classical labor values: Properties of economic reproduction. *World Review of Political Economy*, 11(3):388–414, 2020.