# Planning An Eco-Socialist Utopia

Although critics of the left often accuse socialists of magical thinking, the real fantasy is a future where capitalism can provide for everyone's needs within planetary boundaries.

Kento IIDA for Noema Magazine

Essay Climate Crisis

By Drew Pendergrass and Troy Vettese

JUNE 2, 2022


Drew Pendergrass is a doctoral student in environmental engineering at Harvard University.

Troy Vettese is an environmental historian specializing in environmental economics, animal studies and energy history. He is currently a Max Weber fellow at the European University Institute.


*They are the authors of the recent book, "Half-Earth Socialism: A Plan to Save the Future from Extinction, Climate Change and Pandemics" (Verso Books), from which this essay is adapted.*

For Leonid Kantorovich, mathematics was a matter of life and death. The year was 1941, and German and Finnish armies had besieged Kantorovich's hometown of Leningrad during Operation Barbarossa, severing the city's inbound roads and railways to starve it into submission. But a single thread tied the city to the outside world: over Lake Ladoga on the city's eastern flank.

Soviet barges could ferry supplies in the summer, but in the winter sleds and trucks had to make the perilous journey on ice. This "road of life" was the only way to keep millions of trapped civilians and soldiers in Leningrad alive and fighting. It was a treacherous and deadly road — some 40 trucks fell through the ice during the first week of the winter convoy. With the threat of the Luftwaffe overhead, Kantorovich's job was to minimize these losses. If he failed, the city would not hold out for long.

The lake presented an urgent mathematical problem: Given the wind, temperature and thickness of the ice, how many trucks could be sent over, and how heavy could they be? Rapid changes in weather conditions and the threat of German planes made the puzzle even more difficult.

Despite the danger, the young professor insisted on being on the ice himself to see the convoys through these challenges. Kantorovich's efforts brought thousands of tons of fuel, food and munitions into the city, and nearly 1.5 million civilians out of it. Adolf Hitler thought he could conquer Leningrad in six weeks; nearly 900 days later, the siege was lifted, and the humbled Wehrmacht retreated westwards.

When he was not busy calculating the margins of life and death at Lake Ladoga, Kantorovich was hard at work on his masterpiece, "The Best Use of Economic Resources." While his early mathematical work had been in the abstract fields of analysis and topology, this book was as practical as the road of life.

---

*"Just as he had optimized the convoys across the icy lake, the young mathematician sought to optimize socialism itself."*

---

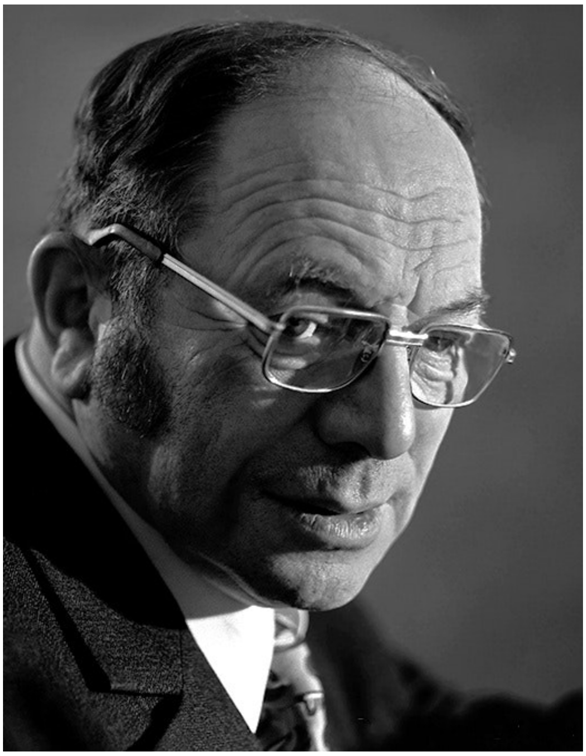
Kantorovich's study delineated how "mathematical methods" could be applied to the "whole economy" on a "scientifically planned basis." While he stressed that a capitalist economy could never approach such a degree of rationality, he politely recognized that "planning deficiencies exist as a direct result of economic science lagging behind the requirements needed in the building up of a communist state."

The "Best Use of Economic Resources" was an attempt to provide an economic science commensurate with the utopian ambitions of the Soviet Union. In place of the self-interested and often inefficient decisions made by the central planning bureau, Gosplan, Kantorovich imagined that algorithmic planning could increase efficiency at every scale, from factory to nation. Just as he had optimized the convoys across the icy lake, the young mathematician sought to optimize socialism itself.

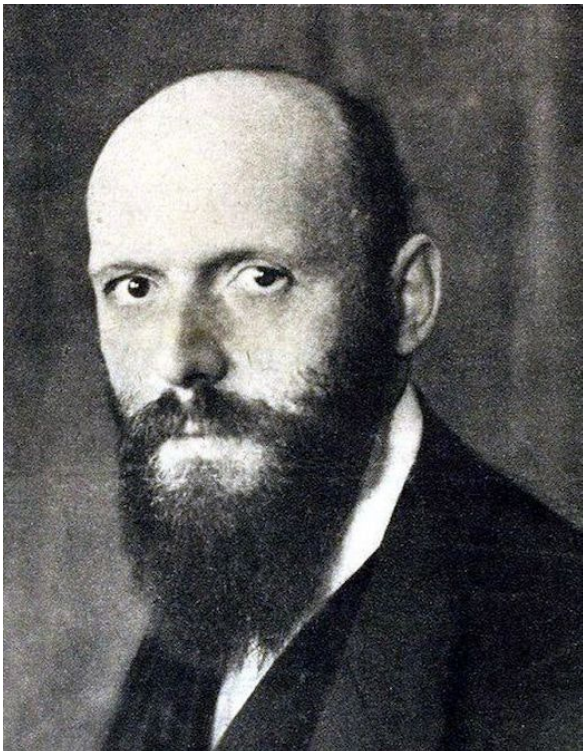
Kantorovich’s pathbreaking work on mathematical solutions to complex economic production questions had begun at a plywood factory three years earlier. The factory’s engineers asked Kantorovich to help them figure out the best way to use their lathes, saws and other machinery — all of which operated at different rates — in order to maximize output of a mix of plywood.

The problem sounded easy enough, but Kantorovich quickly found solving it classically would require over a million equations. So he developed an algorithm he called “linear programming” and devised a solution in an afternoon using only pen and paper. What’s more, the algorithm could be universally applied to any situation where a particular value subject to linear constraints had to be maximized or minimized (designing a train schedule that minimizes passenger travel time, for example).

Linear programming was not only a quintessentially socialist kind of mathematics because it was “characterized by a constant overlap of theory and practice,” but it also offered a way to make a socialist political economy more efficient and rational. Kantorovich immediately began to imagine how his method could be scaled up from the factory to the nation, even the world.



Leonid Kantorovich in 1975. (Wikimedia Commons)



Otto Neurath in 1919. (Wikimedia Commons)

Kantorovich seemed unaware of the work of an earlier socialist economist, the remarkable but largely forgotten polymath of early 20th-century Vienna, Otto Neurath. The kernel of Neurath’s philosophical system was the rejection of “pseudorationality”

— the belief that any single metric, like money, could guide all decisions within any system, economic or otherwise.

Capitalism is an inherently irrational system because the pursuit of profit to the exclusion of all other considerations leads to disaster, such as the climate crisis and the sixth mass extinction. Notably, Neurath extended this insight to socialist economics and argued that an alternative system based on a universal equivalent (labor time, for example) would also lack the necessary conscious control that could rationally and democratically weigh tradeoffs between the incommensurate ethical, social, environmental and aesthetic considerations that comprise any decision. Neurath reasoned that socialism could not be based on market mechanisms, so he criticized the desire of fellow socialists to maintain the "uncontrollable monetary order and at the same time to want to socialize" as "an inner contradiction."

Neurath came to these conclusions by studying ancient and contemporary examples of economies based on "natural" (or "in natura") units of discrete physical things, rather than money. In 1906, he finished his doctoral dissertation on the non-monetary economy of ancient Egypt. He was convinced that money did not necessarily represent an advance in economic history, as "the large store-keeping economy of the ancient Egyptian kings and princes, with their accounting facilities, their wages in kind and other institutions was on a much higher level than the Greek money economy of the fourth century [BCE]."

---

*"Capitalism is an inherently irrational system because the pursuit of profit to the exclusion of all other considerations leads to disaster, such as the climate crisis and the sixth mass extinction."*

---

Neurath employed his insights from ancient Egyptian economics to study war economics during the Balkan Wars (1912-13) and World War I. He came to see in natura calculation as the solution to the problem of pseudorationality. After all, he argued, there were no "war units" to guide a battleship commander's decisions. What mattered were incommensurate things: "the course of the ship, the power of the engines, the range of the guns, the stores of ammunition, the torpedoes and the food supplies." In an emergency, prices fail to convey any information at all.

Twenty years later after Neurath theorized the possibilities of in natura socialism, Kantorovich's linear programming offered what was perhaps the first practical method to actually implement it. Rather than reducing everything to a universal equivalent (like price), Kantorovich could balance competing restrictions in their natural units — tons of steel or watts of electricity — across many different projects simultaneously.

While not sufficient to organize something as complex as an economy, linear programming marked a conceptual breakthrough in planning theory. It offered a systematic way to allocate resources and thus optimize selected metrics of national well-being. That is, as soon as a planner could articulate the material constraints of an economy using mathematical language, plans of production and distribution could naturally follow without the aid of the market's invisible hand. Even with the primitive computers available in the 1940s, Kantorovich could dream of "programming the USSR."

In many ways, Kantorovich embodied the optimism of the "thaw" period after Stalin when rapid economic growth, the new universal science of "cybernetics" and the space age seemed to herald the coming of an abundant and humane socialism. Yet, despite these promising conditions, linear programming failed for two reasons: After the Prague Spring of 1968, anything that smacked of "market socialism" (a tradition that Kantorovich only tangentially belonged to) was compromised, leaving reformers little chance of revitalizing the USSR's increasingly decrepit planning apparatus. And second, the lack of democracy in the Soviet Union meant that it was impossible to assemble a new political coalition strong enough to overcome the vested interests of economic planners and managers, who enforced the Communist Party's five-year plans.

Optimizing the whole economy would rob this elite of their power over the distribution of resources. Reformers were allowed to optimize individual factories or even industries, but never the economy as a whole. Even a highly decorated technocrat like Kantorovich could not realize the dream of an efficient, moneyless, socialist economy because no social movement existed that could help him overcome elite opposition.

Neurath made clear that conscious control is a planned economy's greatest strength compared to capitalism, but it requires democracy to prevent authoritarian and inefficient supervision over the production and distribution of goods. In this way, we could say that linear programming remained a doomed demi-utopian proposal as long as it was not integrated within a broader liberatory project.

Democracy has become only more necessary in the globalized world that socialism will inherit, in which different locations will have specialized roles in the economy and will require supplies produced in faraway regions. Planning will require extraordinary efforts to ensure that no one is excluded or exploited in a global network of interdependence.

> *“Today, capitalism has never offered a bleaker future, while socialism has never been more feasible and necessary.”*

As Kantorovich understood it, the goal is not to micromanage every pound of coffee or piece of steel rebar around the globe, but to “construct a system of information, accounting, economic indices and stimuli which permit local decision-making organs to evaluate the advantage of their decisions from the point of view of the whole economy.” Thus, it is necessary to marry Kantorovich’s technical vision to Neurath’s “scientific utopianism,” in which planners lay out their goals and constraints in natural units and then devise different plans that could be chosen by an informed public.

Today, one could imagine that these plans would represent many possible futures for a socialist planet — one might involve geoengineering and the conveniences of fossil fuels, while another could abolish the use of hydrocarbons entirely. The costs of each of these possible futures can be estimated in natural units, making clear the difficult trade-offs that must be made. Parliamentary representatives could decide on a plan, or perhaps the choice could be put directly to the people in a referendum. Neurath called these various imagined futures “scientific utopias,” and saw them as foundational to economic democracy.

Creating plans based on in natura calculation and putting them to a vote would demystify the economy, making it more difficult for a selfish bureaucratic caste to obscure and thus control its workings. Although the methods required to coordinate today’s economy would be considerably more complex than the linear programming Kantorovich originally employed, the need for democracy is no less pressing.

Today, capitalism has never offered a bleaker future, while socialism has never been more feasible and necessary. Yet, even a wisely managed eco-socialist utopia would still be plagued by some inefficiencies and shortages. However, we believe it is worth paying to gain other advantages, such as a stable climate, wondrous biodiversity and respite from pandemics. Such a society, what we call “Half-Earth socialism,” also promises the prospect of a global polity predicated on care, equality and unalienated labor. Our proposal is only one of many ways that humanity could navigate the environmental crisis, and, in the spirit of Neurath’s democratic vision, we invite others to contribute their own scientific utopias.

Creating a just world that fits within ecological constraints is the road of life that humanity must cross in the 21st century. During the siege of Leningrad, Kantorovich understood that trucks would crash through the ice if they were loaded too heavily, but if they were loaded too lightly, people would starve unnecessarily. Half-Earth socialism requires a similar balancing act, supplying everyone with the material foundations for a good life — sustenance, shelter, education, art, health — while protecting the biosphere from destabilization.

In the scientific literature, this challenge is known as the "planetary boundaries" debate, in which scientists calculate how to provide for everyone's basic needs without trashing the planet. Such a research program, however, is incomplete if it fails to recognize the impossibility of reaching these goals within capitalism. The need to plan and constrain humanity's interchange with nature conflicts with the unconscious, expansive force of capital.

Although there are many estimates of planetary limits, even the most advanced models are unable to help one imagine post-capitalist ecological stability. This is not for a lack of technical know-how. Systems engineers at key institutions have built massive supercomputer programs called Integrated Assessment Models (IAMs) that combine physics, chemistry, biology and economics into a single simulation of the world for the next 300 or so years. IAMs are central to climate politics; anytime you hear a prediction about climate projections for 2100, an engineer with an IAM has probably been tinkering behind the scenes with variables such as pollution taxes, probabilities of technological breakthroughs, spatial patterns of agriculture and biofuels, global food demand, the makeup of energy systems and the sensitivity of the climate and biosphere to all these social changes.

IAMs are powerful tools, but they also demonstrate the problem of Neurathian pseudorationality. For instance, bioenergy with carbon capture and storage (BECCS) is favored by IAM modelers not because it is an effective or realistic solution to climate change, but because IAMs rely on the universal equivalent of money (even transforming CO2 into cash via a carbon tax), and BECCS is a useful way to transform dollars into negative emissions *within a model*. Give a BECCS plantation x dollars a year from a carbon tax and you will sequester y kilograms of carbon from the atmosphere.

---

*"Research into 'planetary boundaries,' in which scientists calculate how to provide for everyone's basic needs without trashing the planet, is incomplete if it fails to recognize the impossibility of reaching these goals within capitalism."*

---

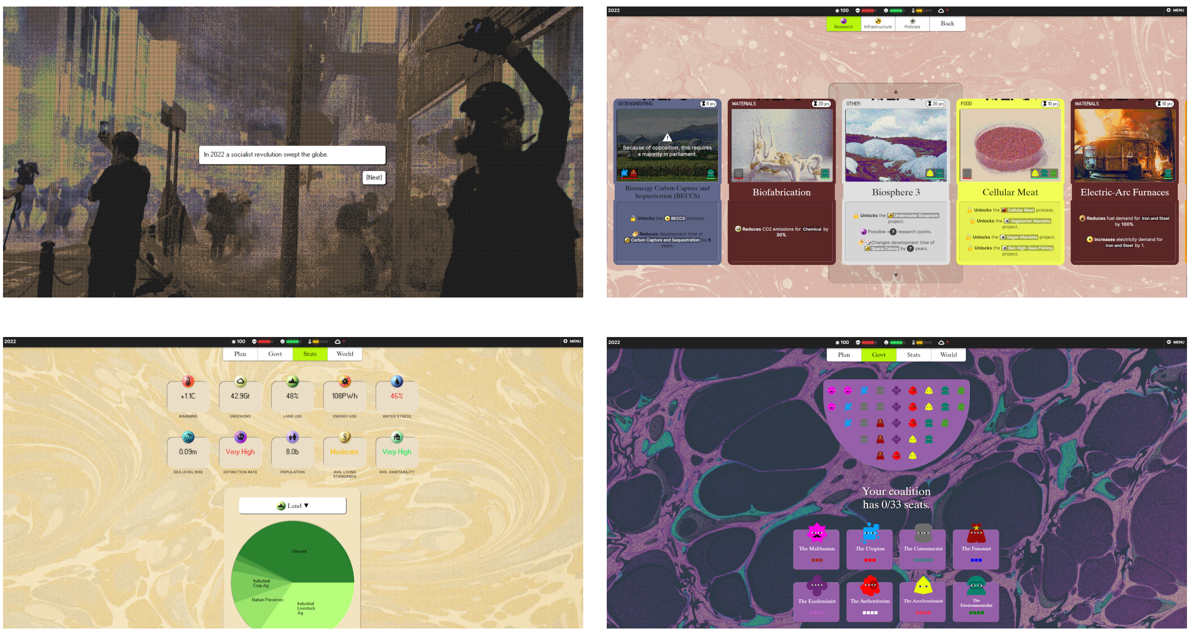
Pseudorationality has now given the illusion that climate change can be reduced to a simple algebra problem. Clearly, another kind of political economy — eco-socialism

— is needed. This method should allow us to think in terms of trade-offs between discrete and incommensurate goals, much like Kantorovich's calculations on Lake Ladoga, without money or other universal equivalents distorting global plans.

This is not to say that the modelers are clueless — indeed, many systems engineers understand that an enormous revolution in energy systems, drastic cuts to individual consumption and radical resource redistribution from the global north to south are required to create a just society with a stable biosphere.

Yet, like the scientists who research planetary boundaries, too many modelers lack a political program that is able to realize the transformation they dream about. Their position is like Kantorovich's at the height of his influence in the 1960s — prestige and knowledge cannot change the world when stymied by powerful vested interests.

Science combined with a large social movement can be a powerful force, such as the anti-nuclear movement during the Cold War. Nothing scares neoliberals more than radical science allied with social movements, but until such a union arises, they have little to fear. Without a drastic political rupture, modelers will continue to be forced to rely on ever more unlikely deus ex machina, such as BECCS and solar geoengineering. Although critics of the left often accuse socialists of magical thinking, the real fantasy is a future where capitalism is constrained within planetary boundaries.




In the spirit of Otto Neurath's vision of "scientific utopianism," the authors worked with designer Son La Pham (Trust) and programmer Francis Tseng (Jain Family Institute) to design a video game (https://play.half.earth) where you can take on the role of a planetary planner seeking a safe passage for humanity through the environmental crisis. The game is based on rigorous science, including a climate model (HECTOR), and players can choose from a wide array of technologies, policies and infrastructure that will lower global temperatures, raise living standards and influence many other environmental and social metrics.

Half-Earth socialism is a scientific utopian project, but that does not mean we are restricted to the tools and concepts that Neurath himself used. Even Kantorovich's sophisticated mathematics is hardly cutting edge now. While the static, one-off calculations made using linear programming are a valuable tool in managing any complicated project — the method is ubiquitous in contemporary applied mathematics, including in planning renewable energy systems — global planners will need other tools to allow local administrators to meet the needs of the people they serve, while simultaneously achieving global goals such as rewilding or long-distance trade.

In natura calculation does not mean replacing money with an inefficient barter economy (x kilowatt-hours of power equals y bushels of grain) but rather uses an information system that allows one to see how different goods relate to one another as a whole. Meeting the needs of nature and humanity is fundamentally a material goal, measured in food and carbon molecules, and seeing the world in natural units allows us to directly confront trade-offs without the obfuscation of money.

Many previously proposed planning schemes rely on labor time as a universal metric to organize production and distribution. Such schemes expend enormous effort in designing a system that corrects for the inevitable distortions created by this strange kind of money or "time chits" because it is difficult to account for the fact that some workers are more effective than others, or some work is more skilled. The goal of socialism is not to replicate the market, but to allow humanity to consciously regulate itself and its interchange with nature.

As a thought experiment, bracketing the practical politics for a moment, imagine that an eco-socialist revolution happens tomorrow. Perhaps the United Nations would become a global parliament, with nations and regions acting as federated units with their own devolved powers. Whatever such a world government looks like, it must be democratic and broad-based to avoid missteps made by previous socialist regimes.

The new regime, composed of representatives from around the world, must immediately start the hard work of planning the world economy, but first they commission social engineers to do some quick calculations on balancing human needs with planetary boundaries and assign them to a new bureau of our planetary future called, say, Gosplant (forgive us). Think of it as some initial back-of-the-envelope estimates of the tradeoffs our imagined parliament will face.

Gosplant's initial goal is to devise several futures that illuminate how much of nature can or should be humanized to furnish the global economy with the necessary resources. It might model futures that allot higher or lower per capita energy use, assume different rates of technological or infrastructural progress and commit to varying degrees of rewilding, making visible the different obligations people will have to shoulder if they wish to achieve certain ecological goals.

---



---

For even a simple version of this simulation to work, however, information must be gathered on a global scale and protocols established that can translate chaotic reality into natural units. The scientific corpus on planetary boundaries allows Gosplant planners to mathematically express two essential restrictions: limiting extraction to keep the biosphere healthy, while equitably distributing enough natural resources to supply human needs.

In one possible plan, half the Earth will be set aside for rewilding to limit the ecocide of the sixth extinction. This is the "half-Earth" that inspires "half-Earth socialism," a concept championed by E. O. Wilson and other conservationists because land-use change — often carried out by the meat industry — is the principal driver of the current mass extinction event. Protecting so much land will require significant changes (especially in terms of meat consumption), but conservation must abjure its colonial heritage. There are strong ethical and even environmental reasons for a radical left conservation program; after all, Indigenous lands sequester more carbon and harbor more biodiversity than nature preserves. Indeed, half-Earth socialism complements the global Land Back movement.

---

*"Although critics of the left often accuse socialists of magical thinking, the real fantasy is a future where capitalism is constrained within planetary boundaries."*

---

On top of the territorial restriction of half the Earth being rewilded, scientists have provided global figures on a myriad of other ecological limits, from the maximum amount of nitrogen and phosphorus that can be used as fertilizer (68 million and 6.8 million tons per year respectively) without causing mass eutrophication to the freshwater available for consumption, to the carbon that can be emitted (1.8 tons per person per year for 2 degrees Celsius of warming, even less for the more ambitious 1.5-degree target). Further restrictions on acceptable levels of pollution can be taken from the public health literature — for example, fine particulate matter suspended in the atmosphere should have an annual mean of 10 micrograms per cubic meter or less. None of these limits should be taken as immutable — scientific knowledge reflects not only the latest technique and theory but also social concerns that are far from "objective." Our imagined parliament would commission a variety of plans, embodying a variety of possible futures.

To plan for energy and food production, Gosplant will make several plans with different power quotas, like that proposed by the 2000-Watt Society, and ensure that everyone in the world will have access to a nutritious diet. These choices, like many of Gosplant's other constraints, are all social decisions.

Some scholars have ventured energy quotas lower than 500 watts, which is less than a twentieth of current U.S. usage. More conservative targets are possible — they would just require spartan restrictions on new clothing, appliances, transportation, electricity and living space. Gosplant need not make this choice for everyone; they can generate many plans, each with its own energy quota, and leave it to the people and their representatives to decide which plan best balances the needs of the biosphere and humanity.

Linear programming is a powerful protocol that can turn these various constraints (expressed in natural units) into concrete plans. Anyone can toss in limits on resource use and the minimum needs of humanity and turn the crank. The Gosplant social engineers need not harbor *any explicit preference* between diets, energy systems and other variables. There is no inherent requirement in their linear programming model that the world be vegan, or that all power sources be renewable.

In our basic example, the planners set two main goals — providing enough food and energy for everyone's basic needs and staying within planetary boundaries — as well as the basic productive configuration needed to satisfy those goals by different means. The final piece of the puzzle is called the objective function: the quantity that the linear programming algorithm must maximize or minimize.

A capitalist firm might decide to minimize costs when running a linear programming algorithm on its own operations; the Gosplant planners, on the other hand, might opt to minimize land use, carbon emissions or some other metric that combines multiple goals. The linear programming model will then output the best mixture of energy and food sources with respect to this objective function or tell the user that the plan is not possible within the given constraints. (We should emphasize that what we are doing here is a toy example, designed to illustrate how a future society might weigh trade-offs in natural units, and is not trying to argue that simple linear optimization can run the world.)

To understand how linear programming digests its inputs, consider the question of diet. Everyone could eat a healthy diet, but there are multiple ways Gosplant could achieve this goal. If the great majority of people were omnivorous, this would impose a per capita cost of around 2.5 acres of land and 2.25 tons of carbon per year. Vegetarianism does much better, taking up only a third of an acre per person and 1.5 tons of carbon. Veganism pushes land use down a little further and emissions more substantially, to just over a ton per person. A slew of other reforms could — and indeed must — improve these figures much more.

---

*"Meeting the needs of nature and humanity is fundamentally a material goal, measured in food and carbon molecules, and seeing the world in natural units allows us to directly confront trade-offs without the obfuscation of money."*

---

Even though the Gosplant bureaucrats do not explicitly prefer any diet, their linear programming algorithm will likely opt for veganism because it satisfies the requirement of feeding everyone with the smallest environmental impact. If society resists shifting to an herbivorous diet, the planners could include some meat production. However, increased emissions and agricultural land use will cut into other aspects of the total plan. Linear programming is only a tool, but it is one that allows the Neurathian politics of seeing and democratically deciding which trade-offs to accept.

The transition to a vegan world would impose greater sacrifices on the carnivorous global north, which is only fair — the average North American eats almost 10 times more meat than the average African. A nearly vegan "planetary health diet" outlined by a recent EAT-Lancet study proposes a 2,500-calorie quota per person that would not only lessen humanity's impact on the environment but also prevent an estimated 11 million deaths per year. There would be less malnutrition, as well as fewer conditions such as type 2 diabetes and heart disease caused by the over-consumption of meat and certain processed foods. Replacing livestock fodder with pulses and legumes would increase natural nitrogen fixation (and thus reduce the need for a fossil-fuel-dependent fertilizer industry), while allowing pasture to be rewilded.

A more fully developed linear programming model might account for these benefits in more granular detail, better reflecting the myriad social, ethical and ecological benefits of veganism. The world's moral issues will never be solved by a computer, but algorithmic planning can clarify the discussion.

The social engineers would address energy in a similar manner to food. Each person on Earth would need to be supplied a power quota, whether 2,000 watts or something else, but again there are many ways to do so. Suppose Gosplant has eight main sources of energy to choose from: photovoltaic solar cells, concentrated solar power stations, wind turbines, biofuels, nuclear, methane ("natural gas"), coal and petroleum. For simplicity's sake, and because the anti-nuclear movement was a vital constituent in the Half-Earth socialist revolution, the planners do not include nuclear energy in their initial calculations.

Each of these power sources has a cost associated with it, expressed in natural units of land area and carbon emissions, but not money. Biofuels, for example, are hypothetically zero-carbon (though this is often not true) but have a low "power density." Power density is the relationship between energy and land area, often expressed as watts per square meter. While coal or petroleum could have a power density of 10,000 watts per square meter, biofuels often boast a measly 0.5. This means that several orders of magnitude more land is required to produce a similar amount of energy as fossil fuels. Solar and wind are the best hope for renewables, with power density of 2-20 watts per square meter — quite a bit higher than biofuels but still much less than fossil fuels. The immediate problem, however, is that the majority of power consumption (e.g., transportation, industry) is not on the electrical grid and cannot yet take full advantage of these power sources, and are currently reliant on fossil fuels.

A more sophisticated model could add other costs, such as the environmental and social costs of mining various materials. The idea, however, remains simple: Linear programming requires Gosplant only to lay out goals that have been democratically decided upon, as well as collect the information on the material costs of each variable.

The long-term energy goals of Half-Earth socialism are apparent: total electrification of industry and transportation and making generous use of clean hydrogen where fuels remain necessary, with as much power as possible supplied by wind and solar. Yet, the transformation would be extraordinary: Supplying the necessary electricity would require a 40-fold increase in wind power and a 170-fold increase in photovoltaics as of 2015. As the energy scholar Vaclav Smil points out, "such a ramping-up of all kinds of capacities — design, permitting, financing, engineering, construction, all going up between one and five orders of magnitude in less than two decades — is far, far beyond anything that has been witnessed in more than a century of developing modern energy systems." Even an eco-socialist society that is single-mindedly committed to overcoming the energy challenge would struggle to pull off such a change.

After calculating the land and emissions costs of various diets and energy systems, Gosplant bureaucrats would have enough data to run a simplified linear programming model and supply a basic global plan. Like some early IAMs, such as William Nordhaus' Nobel Prize-winning DICE model, the program we built is basic enough to run on an ordinary laptop in less than a second. However, like Nordhaus' model, ours is far too simple to be used in real life. (Such limitations never stop economists.)

Planners could set several constraints, including an energy quota; various planetary boundaries, such as global temperature or the amount of land set aside for wildlife; and the state of infrastructure and industry (e.g., to what extent are they electrified?).

Gosplant would have to decide whether to minimize land use or CO2 emissions, in addition to setting energy and food quotas. The numbers underpinning these variables are based on the current state of technology in various fields — so no cold fusion or fast-breeder reactors. The only futuristic element in our model is population, which we set at 10 billion people — the estimated global population in 2050.

Where would the immediate difficulties for a transition lie? Pessimistically, Gosplant engineers might assume that transportation and industry remain unelectrified and consume the bulk of energy, as is the case in the U.S. today, and thus require vast quantities of fossil fuels or biofuels to meet humanity's needs. So they have three main goals: provide a 2,000-watt quota for all, limit warming to 2 degrees Celsius and rewild half the planet.

With their goals settled, all the Gosplant planners need to do is pick an objective function. They decide to minimize land use. However, when the bureau runs its model, it finds that the plan's goals cannot be met, even if everyone became vegan. Biofuels would compose such a large share of the global energy budget, there would be no way to grow enough food and energy crops without transgressing the threshold of the half-Earth.

This would then entail geoengineering or biodiversity loss caused by the huge biofuel plantations. If they wanted to, Gosplant could add these terrible possibilities into the model and relax their planetary boundary constraints. Importantly, any model actually used for planning should simulate change over time, with emissions above the quota now and lower or even negative emissions in the future. Although things seem dire, it is too early to give up on utopia.

The planners have several options. One would be to reduce the energy quota to 1,500 watts, which would make the rest of the plan viable even without electrifying transit and industry. The model shows that 57% of the planet's habitable surface could be left to nature (up from 15% now), 26% would be dedicated to biofuels (up from about 0.4% now) and 18% to agriculture (down from 50% now).

---

*"Every part of half-Earth socialism should be seen not as an unquestionable truth but as a starting point for a deeper discussion of how socialism should function in an age of ecological crisis."*

---

The assumption that allows this plan to work is that virtually everyone would be vegan (with exceptions made for Indigenous nations and perhaps some traditional pastoralists). The model also shows that, because energy use would be so low, methane could be used for some industrial processes and electrical generation while still limiting warming to 2 degrees Celsius.

Although the plan is feasible, the planners are reluctant to create a massive biofuel industry. They devise another option by simulating strict restrictions on private car ownership and unnecessary industrial processes, which halves the demand for solid and liquid fuels. In this modified plan, biofuel crops take up only 21% of the planet's surface. An even more ambitious option reduces the energy quota to 1,000 watts and would require biofuel plantations on only 13% of Earth's surface, while reserving an astounding 70% for wildlife.

Wonderful news! Even with quite pessimistic assumptions, Gosplant can plot several paths towards an equal, sustainable planet. However, the blueprint drafting cannot stop there. Anticipating possible demands from climate activists, the Gosplant planners devise another blueprint that opts for the courageous goal of limiting warming to only 1.5 degrees Celsius. After rerunning the algorithm with the 1,500-watt quota and the restricted fuel-use scenario, their model shows that this goal will require the biofuel sector to expand to over 25% of the planet's surface (up from 21% before). Warming would stay below 1.5 degrees Celsius, but at the cost of having taken more land from nature due to much stricter restrictions on fossil fuels.

There are no easy solutions here, and our Gosplant model clarifies the trade-offs required in every plan. Ultimately, a global parliament would have to take a vote on whether minimizing climate change or preserving habitat is the more urgent planetary goal — or whether the planners should go back to the drawing board and come up with more arrangements.

Other options become possible with new infrastructure and technology. Perhaps there is a breakthrough in "green" hydrogen fuels, which allows the Gosplant social engineers to pursue the goal of total electrification. This leads to their most ambitious plan yet: an energy quota of 2,000 watts and 50% of land rewilded, all within the limit of 1.5 degrees Celsius warming.

In this blueprint, electrification allows Gosplant to take full advantage of solar and wind power, which have much higher power densities than biofuels; with land use minimized, a whopping 81% of land can be left to nature (thus preserving 95% of all species). The planners find that up to 24% of the population could be omnivores in this scenario, as land constraints are so relaxed as to permit the return of some animal husbandry. Of course, a vibrant animal-rights movement would still oppose this for ethical reasons, while epidemiologists might warn against the threat of zoonotic disease. The point, however, is that the social engineers' plans could and would evolve alongside infrastructural and political change.

Our model's simplicity leads it to overestimate the role of biofuels in a real-world transition: In reality, a good strategy might be temporary restrictions coupled with rapid electrification, with some very limited carbon removal technologies used to mop up the last of the "hard-to-decarbonize" emissions like cement clinker. Even in this case, though, the land/power tradeoff remains important. Carbon removal, whether through rewilding or BECCS, takes up a large amount of land.

---

*"A socialist society confronts these challenges with open eyes, rather than trusting the mythical powers of the market."*

---

Imagine that, for the short term, the global parliament opts for the second modified plan, with a 1,500-watt energy quota and restrictions on fuel use. It is the best fit for present circumstances while allowing energy use to grow in the future as more sustainable infrastructures are built. (That quota would seem austere in the global north, though relatively painless for the south.)

The government agrees to steadily reduce private car ownership to the point of complete abolition, one compacted Ferrari at a time. The steel thus saved can be recycled into trams and buses, while the remaining cars (which would run on electricity, hydrogen or biofuels) are pooled and signed out by individuals or families. While Gosplant liquidates the suburban real estate market early on, millions of construction workers and tradespeople find work retrofitting buildings to conserve energy and adapting private mansions and corporate headquarters to communal use.

Private lawns and golf courses are likewise either rewilded or turned into community gardens. Wide-ranging improvements to industrial processes to reduce pollution, fuel use and waste are undertaken in just about every industry. Large swathes of manufacturing become rationalized when "planned obsolescence" itself is made obsolete. Resources are redirected toward building solar panels, wind turbines, super-efficient insulation and railways.

Much of the world's pasture is converted into biofuel plantations for the short-term decarbonization of transportation and industry, while the remainder is rewilded, which in turn requires an expanded cadre of ecologists and foresters trained in both conventional science and traditional Indigenous knowledge.

Gosplant's job is not to dictate what the future should look like but to supply the public and its representatives with blueprints. For Gosplant, the process is more important than the final product.

Every part of half-Earth socialism should be seen not as an unquestionable truth but as a starting point for a deeper discussion of how socialism should function in an age of ecological crisis. Planners, parliaments and people will never have full knowledge of nature and society, which will lead to blind spots that even the most meticulous plans will not be able to perfectly address. These weaknesses are to be expected in any plan that confronts the catastrophes of the Anthropocene.

But our hope is that half-Earth socialism will differ by producing a society that constantly revises itself towards a more just and environmentally stable civilization through conscious choice. This does not mean that creating a global utopia will be easy. Yet, a socialist society confronts this challenge with open eyes, rather than trusting the mythical powers of the market. In such a struggle lies the possibility of human freedom on a self-willed natural world.

*This essay is a modified excerpt of the authors' recent book, "Half-Earth Socialism: A Plan to Save the Future from Extinction, Climate Change and Pandemics" (Verso Books).*

---



---

MORE FROM NOEMA MAGAZINE

'The Grievers' Of Climate Change

Erica Hellerstein

There Is No Such Thing As Italian Food

John Last

Concrete Built The Modern World. Now It's Destroying It.

Joe Zadeh

NOĒMA Published by the Berggruen Institute