Fragmented Abundance:
Disjunction and Uncertainty in a Solar Economy

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Contents

Abstract

This project examines contemporary capitalism's relationship to abundance and uncertainty, via the political economy of electrical infrastructure. Echoing Bataille's notion of solar economy, in which the primary problem is not scarcity but managing excess, I orient around a case of relative wealth and literal solar energy abundance: California's electricity grid, especially from the 1990s to the present. Whereas much recent attention to infrastructure has focused on moments of breakdown, I develop the conceptual terrain surrounding positive investments in infrastructural mediation of the human-earth metabolism. In attempting to smooth over the uncertainty and intermittency introduced by renewable energy, electrical infrastructures work to compose abstract, homogeneous spacetimes insulated from other rhythms (producing stasis out of flux). By maintaining this type of gap, I show how the category of infrastructure occupies a key point of convergence between Marx's theory of metabolic rift and Deleuze and Guattari's concept of disjunction in *Anti-Oedipus*, in a way that opens questions about the meaning of communism today (with ecological issues given prominence). Part I describes the problem of intermittency and its driving role in grid dynamics, showing how capital seizes on this to recapture the potentials of solar energy. Part II examines different figurations of the concept of planning, which is often suggested as a means of reining in capitalist irrationalities of this type. For an articulation of planning sensitive to questions of self-sufficiency, scale, and uncertainty amidst abundance, I turn toward Harney and Moten's *The Undercommons*, asking how their framework might bear on questions of energy, ecology, and infrastructure.

Résumé

Ce travail examine le rapport du capitalisme contemporain à l'abondance et à l'incertitude, via l'économie politique des infrastructures électriques. Faisant écho à la notion d'économie solaire de Bataille, dans laquelle le principal problème n'est pas celui de la rareté mais celui de la gestion de l'excès, je considère un cas de richesse relative et d'abondance littérale d'énergie solaire : le réseau électrique californien, en particulier depuis les années 1990 à aujourd'hui. Alors que l'attention récente portée aux infrastructures s'est concentrée sur les moments de dysfonctionnement, je développe le terrain conceptuel autour des investissements positifs dans la médiation infrastructurelle du métabolisme humain-terre. En tentant de dissiper l'incertitude et l'intermittence occasionnées par les énergies renouvelables, les infrastructures électriques créent des espaces-temps abstraits et homogènes, isolés des autres rythmes (produisant une stase à partir des flux). En maintenant ce type de séparation, je montre comment la catégorie d'infrastructure occupe un point de convergence entre la théorie de la rupture métabolique de Marx et le concept de disjonction théorisé par Deleuze et Guattari dans *L'Anti-Œdipe*, d'une manière qui soulève des questions sur la signification du communisme aujourd'hui (les problèmes écologiques étant mis en évidence). La première partie décrit le problème de l'intermittence ainsi que le rôle moteur que joue celle-ci dans la dynamique des réseaux, en montrant comment le capital s'en sert pour récupérer les potentiels de l'énergie solaire. La deuxième partie examine différentes représentations du concept de planification, qui est souvent suggéré comme moyen de mitiger les irrationalités capitalistes de ce type. Pour une articulation de la planification sensible aux questions d'autosuffisance, d'échelle et d'incertitude en milieu d'abondance, je me tourne vers *The Undercommons* de Harney et Moten, en explorant la pertinence de leur cadre théorique pour les questions d'énergie, d'écologie et d'infrastructure.

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This project forced me to confront the relationship between place and thought in many ways, both personally and methodologically. Moving to Canada has shown me a different face of North America, and has convinced me more than ever of an undercurrent in this thesis: that what makes this continent interesting to think from has far from exhausted itself. Whatever might be made of the future against the storms of the present demands (much more than) acknowledgment of the past. This work took place in Tio'tia:ke, as Montreal is called by the Kanien'kehá:ka, who are still here and never ceded it. The place has left a direct imprint on the direction and substance of this thesis. For me, Montreal/Tio'tia:ke will always be a city of anarchists.

Introduction:
Infrastructure, Rift, Disjunction

> It is not the unity of living and active humanity with the natural, inorganic conditions of their metabolic exchange with nature, and hence their appropriation of nature, which requires explanation or is the result of a historic process, but rather the separation between these inorganic conditions of human existence and this active existence, a separation which is completely posited only in the relation of wage labour and capital.
>
> – Marx, *Grundrisse*

In a historical survey of the physical concept of energy, American physicist R. Bruce Lindsay argues that its origins lie in the notion of "invariance" or "constancy in the midst of change." The basic sense of this concept is a quantity that persists through transformation or exchange (a notion formalized with the first law of thermodynamics, or conservation of energy, in the 19th century). Of an aggregate of particles, energy refers to what "stays *constant in time*, no matter what the motions of the particles may be." He traces two origins of the concept from Greek antiquity. The first is technological, stemming from investigations of the properties of machines and the observation of compensating forces in mechanical systems, such as levers and pulleys. The second is philosophical, connected with the Heraclitean doctrine that "all things flow" (such that change is the only constant, and constancy is itself composed of underlying change, like the flow of a river that persists as what it is only by constantly changing). However, in Lindsay's view, this concept of energy finds its fullest expression in Parmenides, for whom all change is in a sense illusory, and what is true in being is what is constant, invariant, and eternal despite the flux of experience. Thus, he claims, "If we seek an ancient patron saint of the concept of energy, it will surely be Parmenides."[1]

[1] R. B. Lindsay, "The Concept of Energy and Its Early Historical Development," *Foundations of Physics* 1, no. 4 (1971): 383–93.

This play of change and invariance provides an apt starting point for the tensions, contradictions, and aporias presented by electrical infrastructures. Indeed, there is a sense in which it is intuitive to describe the general category of infrastructure in this way: as what stably endures so that variation can occur around it, like a road that stays in place so that other things can move. Electricity compounds its expression of the principle many times over. It is the substrate for countless social processes, a single ether-like commodity that enables an explosive profusion of kinds and quantities of production and consumption. Materially, electrical current itself exists only as flow, remaining difficult to store at the scales required by industrialized societies, and yet it enters our lives via a durable network of machines of generation, distribution, and consumption. Phenomenologically, in some locales, a restless abundance of electrons is gathered and mediated in such a way as to produce a uniform, reliably unchanging capacitation; in others, perhaps, the contradiction appears between the fixity of the infrastructure and the unreliable intermittency of what flows through it. Where it exists embedded in capitalist economies, electricity is deeply entangled with the uncertainty of markets, and yet within these it is often marked out as a specially regulated public good, considered both a basic necessity and a relatively stable investment. The uncertainties involved traverse any supposed ontological divide between social and natural forces, as grids must contend not only with fluctuating demand, the growth of populations and of needs, but also increasingly with fluctuations in the weather as renewable, intermittent sources like solar and wind are folded into the mix (to say nothing of the diminishing of the fossil fuel supply that has stabilized them until now). Whatever else they are, electrical

infrastructures are mediators or transducers of uncertainty, attempting to transform it into predictable reliability.

My claim in the present study is that this play of stasis and flux, of predictability and uncertainty, as manifested in our energy relations and in the category of infrastructure, has something important to contribute to the study of political economy and ecology today, at a moment when capitalism, mediated in no small part through appetites for energy, threatens biospheric exhaustion and collapse. We all know or intuit this, however vaguely: in many circles, it has become boilerplate to assert that ecological devastation is "intrinsic to the logic" of capitalism, and we all know that energy is a crucial part of the story. But as recent debates over the relations between capitalism, materialism, and nature attest, it is by no means settled why this is the case, how it works, or what its real political implications are, beyond a vague though indispensable imperative to bring capitalism to an end. The main body of this project will focus, as an orienting foothold, on a concrete case of energy economy: the recent history of electricity (and especially solar energy) in California. But before "ascending to the concrete," I must say a bit more to frame the stakes and motivation for my approach. If infrastructure inserts itself as a productive middle term between predictability and uncertainty, what does this suggest about its role in economy, ecology, and the relation between the two? What kinds of dynamics and relations are involved in our reliance upon electricity, and what do these contribute to an understanding of contemporary capitalism and the requirements of an economically and ecologically transformed society?

For, Parmenides notwithstanding, the categories of stasis and flux are not simply neutral metaphysical descriptors; these are politically and ethically loaded terms.

Stasis is often associated with rigidity, necessity, closed becoming, and the maintenance of the status quo, while flux suggests freedom, open becoming, and the capacity for change. Here the category of infrastructure can and should give us uncomfortable pause; if infrastructure is about stable maintenance and reliability, it could easily be thought inherently conservative (and certainly, some large-scale systems that we call infrastructures are relatively fixed and resistant to change). But the truth of the matter is more complicated. An infrastructure is not just a large technical object; there is no infrastructure without someone or something that depends upon or *needs* it. Thus, what is politically troubling about infrastructural relation is that it always involves an *articulation* between stasis and flux, between necessity and freedom, rather than simply falling on one side. It involves *difference* rather than equality; it means that some becomings are closed so that others can remain open.

This remains troubling even when what is held in place is not people. Or rather, even then it remains an invitation to politics, and to questions that cut to the heart of what it would mean to live in the consciously and democratically organized mode of production that has often been given the name of communism. As Kate Soper brilliantly argues, Marx's conception of communism contains a fundamental unresolved contradiction or aporia: on the one hand, it is supposed to be a condition in which individual and social development are given free reign to create new needs, desires, and subjectivities, "unmeasured by any previous yardstick"; on the other hand, it must entail collective planning to meet needs, and therefore irreducibly political (and perhaps difficult to reverse) decisions about both which needs/desires are to be met and the

common standards of their measurement.[2] It is in this same gap that questions of infrastructure sit (and perhaps especially, as I will describe later, the notion of a "utility" with its orientation toward use value and something like "need"). Electricity is a prime example of a historically created desire that has been truly decided upon as a need: though clearly not naturally given, for those who have grown accustomed to it, it is about as close as one can get. As Marx argues in the *Grundrisse*, consumptive needs are not wholly abstract and indeterminate (or, it might be said, satisfied merely by a certain quantity or level of production). Rather, they are qualitatively conditioned by history and stamped by the mode of production and social relation in which they arise. Therefore, consumption is ultimately a moment of production, and produces not only objects but also subjectivities and their respective needs: "Production thus not only creates an object for the subject, but a subject for the object."[3] If it is true that, as Marx claims, "Regarded *materially*, wealth consists only in the manifold variety of needs,"[4] then such a profusion of differentiated needs is to be celebrated. Yet it is easy to see how this drastically complicates notions of "distributing according to needs" and "planning to meet needs." Certainly, some aspects of the problem are informational, and could perhaps be aided by new predictive technologies. And yet, as Soper points out, the notion that needs can simply be "read off" from existing behavior is liberal market ideology par excellence, and

[2] Kate Soper, *On Human Needs: Open and Closed Theories in a Marxist Perspective* (Humanities Press, 1981). See esp. 188–96 and 203–13.

[3] Karl Marx, *Grundrisse: Foundations of the Critique of Political Economy*, trans. Martin Nicolaus (Penguin Books, 2005), 92. See also pp. 525–8 on luxuries becoming needs. Interestingly, in the latter passage (which deals with circulation and means of communication), Marx gives the example of a road which "must" be built because it is deemed "necessary" for a given social formation, and which therefore, insofar as its actual production depends upon a certain historically contingent division of labor, tends to drag along said division into the realm of necessity, fixing and naturalizing it as an apparent need as well.

[4] Ibid., 527.

obscures the politics of need, including the fact that this position itself represents a particular politics of need. For her, at a certain point, the question of need must always be followed by the question, "[needed] as a condition of what?"[5] Throughout this project, I will be attempting to remain in the tension of this aporia between affirming the creative expansion of needs and subjectivities (from which there is, barring colossal catastrophe, and perhaps even then, no going "back") and critiquing the assumption that, when it comes to the patterns of consumption involved in a "need" like electricity, there can be no (useful) critique.

There is an ethical aversion to questions of stasis, necessity, and their articulation with flux and freedom that runs deep in much contemporary thought.[6] After all, why not envision a world in which "freedom," pure and alone, would be the universal condition characterizing all beings and relations – once we have debunked the way in which capitalist ideology reduces freedom to the sphere of the market? Questions of infrastructure and ecology alike make this aversion unworkable. Both force us to ask not simply about freedom, but about what makes freedom possible, and will continue to make it possible in the long run, for beings who are not me and may be very much unlike me. Infrastructures stabilize tendencies and involve decisions that may create path-dependencies well beyond the scale of individual life and freedom. At a certain point,

[5] Ibid., 10.

[6] A notable exception is black studies, of which on such matters Saidiya Hartman's work stands as the most substantive, nuanced, and discomfiting that I know. E.g., *Scenes of Subjection: Terror, Slavery, and Self-Making in Nineteenth-Century America* (Oxford University Press, 1997). Clearly, drawing out all the links between this area of work and the questions raised in the present investigation would be a project unto itself, and I would not want to cheapen its significance by doing so offhandedly or pretending that my project is about something that it is not. However, as I will later draw on Moten and Harney's reflections on (something like) stasis and flux, as well as other concepts that I do find directly pertinent to the issues at hand, I want to acknowledge that I do not believe the provenance of their reflections to be an accident, and that they are part of a rich line of inquiry that has been going on for a long time.

does it not appear that the true aversion is to this kind of decision and responsibility?[7] The same difficulties pertain to ecology. There is indeed a conservatism that readily appears in many strains of ecological thought, in which, to be fair, it is difficult and perhaps outright foolish to do without some notion of maintaining the homeostasis of ecosystems and of the biosphere as a whole. Without falling into the conservative traps here, however, does it not remain a hopelessly liberal naïveté to invest one-sidedly in a flattened ontology characterized by a single quality of relation throughout? Why does a description of the world containing only fungible (or, what is ultimately the same, abstractly "singular") objects and indeterminate relations of "connection" or "interaction" between objects so often pass for thinking about ecology? Is this not the image of a completely dead universe – atoms colliding in the void without ever cohering into the rich, vibrant, fully living world that we know and might wish to protect?[8] Real ecology is messy, differentiated, and often violent; we do ourselves no favors by ignoring this, even if we are committed to not simply reproducing the world as it is. Real ecology is precisely about differentiated need and interdependency: one being's waste, byproduct, or very being itself feeding the reproduction of another. It involves beings that do not all need the same thing, do not all interact in the same way, and are engaged in asymmetrical

[7] Cf. Soper, *On Human Needs*, 4: "The fear [of raising the question of needs] is the *imposition* of values that is entailed by any answer to it; it is the fear of the *subjection* to decisions that is the other side of assuming responsibility for them."

[8] I take no issue with the idea that non-biological matter could be considered "living" in the relevant sense (as some cultures hold). My point is, first, not about policing the boundary between life and non-life, but about complexity, organization, and propulsion through time. Second, however, there is a sense in which I am suspicious of the call to attend to "matter," and leave it at that, at precisely the moment when it is the biosphere that is rendered precarious and under threat. To my mind, the move to matter is welcome insofar as it invites thinking about what we mean by life, vitality, "vibrancy," and the like, in ways that can be useful in this moment. But, therefore, it is only the first step. My approach thus differs from, without necessarily opposing, that taken by, e.g., Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Duke University Press, 2009).

relationships. It is such rich diversity that sustains the health of ecosystems, and that characterizes their problem.

In a certain sense, is the issue not a narrow emphasis on an unqualified and undifferentiated notion of production? The charge has long been laid against Marx that he held the development of productive forces, the free development of new needs, to be an automatic good. For certain longstanding trajectories of ecological thought, this was supposed to disqualify him from usefulness on such matters. And yet within more recent theory, although perhaps many names come to mind, does not much of what I have said above recall the ethics of a different framework, which has also been taken to valorize unconstrained free "flows" and desires – that of Deleuze and Guattari, and especially of *Anti-Oedipus*? Here I must introduce two claims that will set the theoretical focus of this project. The first is that these charges do not stick against either body of work, and that the ways in which they fail to stick are precisely what make these thinkers interesting and useful for the present line of inquiry. The second is that historicizing these works provides a key to the relation between questions of infrastructure, energy, and the meaning of communism. Let me now take each of these claims briefly in turn.

It is still common even within self-professedly Marxist approaches to hold that the ecological problem with capitalism is essentially one of quantitative overproduction in general (i.e., unlimited growth on a finite planet), even when great nuance is employed to create rhetorical distance from this claim. For example, Jason Moore argues (correctly) that since capitalism repeatedly exhausts the raw materials of its reproduction, it must continually expand into new territories, bringing them into the fold of capitalist relations; he then concludes (dubiously) that the dwindling availability of new lands, physical

resources, and previously uncommodified "work/energy" must mean that capitalism is now in the process of bringing itself to an end.[9] This particular optimism both obscures the need for political and social intervention and underestimates capital's ingenuity in *producing* new terrain for its reproduction, much of which today comes in so-called "immaterial," informational, financial, or desiring-subjective form (e.g., advertising creating new desires). It could be said that capitalism adopts a strategy of *intensification* where extensive growth in space becomes difficult or impossible.[10] Here I must be clear: the growth problem is deeply important and worthy of serious critique. But how can we neglect the fact that this is, materially, not the direct cause of the particular crisis of global warming, which no critique of energy can fail to address? Without in any way excluding other moments and considerations, carbon emissions invite thinking about the aftermath of production: namely, waste, and especially the *distribution* of waste – its

[9] Jason W. Moore, *Capitalism in the Web of Life: Ecology and the Accumulation of Capital* (Verso Books, 2015).

[10] An analogy would be Marx's theory of absolute and relative surplus value in relation to the working day. Where the temporal extension of the working day has been capped, capital seeks to intensify the labor it can squeeze from labor-power within a fixed limit, by transforming the qualitative forms of that labor (through the greater use of machinery, etc.). Cf. Karl Marx, *Capital, Vol. 1*, trans. Ben Fowkes (Penguin Books, 1976), 643–54. Moore makes frequent reference to the absolute/relative surplus value distinction; his point seems to be that capitalism has always intensified its appropriation of surplus value through the use of technology, especially technologies of mapping and measuring space that facilitated geographic expansion, and other forms of scientific knowledge that determined the use to which such lands were put. In this way he claims that new commodity frontiers are not simply "there for the taking," but are actively "coproduced" by capitalism. And yet this "coproduction" seems limited to knowledge and means of exploitation of what is, in a realist sense, already there. He does not consider, for example, the way that knowledge and information themselves become new frontiers of commodification, or more broadly transform material dynamics, as I will in this project. The general significance of these for me is that they are examples of new "natures" that capitalism truly does, in a fully realist sense, produce or bring into the world. Moore's attempt at "anti-Cartesianism" here does not go very far; his concept of "historical natures" is largely limited to a history of ideal conceptions of nature, and falls back toward reducing knowledge to a reflection or representation of material reality. Similarly, his theorization of unpaid reproductive labor reduces the latter to its "work/energy" components, without consideration of affective and other dimensions of the care labor he seeks to valorize. Cf. Moore, *Capitalism in the Web of Life*, 70–73, 301–2.

accumulation in places and forms where it cannot serve and actively disrupts the reproduction of human and other earth systems.

These are precisely the resources that John Bellamy Foster finds in Marx's actual thinking about ecological issues, most famously in the theory of the metabolic rift.[11] In the industrial capitalism of his day, Marx saw that the geographic division of labor, chiefly that between town and country, results in uneven transfers and accumulation of materials and energy. Nutrients and fibers from rural agricultural production flow into cities, where they soon accumulate as waste and pollution, rather than being returned to the soil to restore its potential for future production. This was a problem of "irrational" distribution, to be solved by rationalized planning and soil management. Like people, the soil has "needs" to be planned for, and in systematically failing to do so, capitalism degrades the potentials of the earth in much the same manner that it degrades labor-power. Throughout *Capital*, Marx repeatedly draws this parallel between capitalism's exploitation of the worker and its exploitation of the soil:

> [A]ll progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is progress toward ruining the more long-lasting sources of that fertility… Capitalist production, therefore, … simultaneously undermin[es] the original sources of all wealth – the soil and the worker.[12]

The parallel is not metaphorical, but rather has a material basis: workers only agree to sell their labor-power, to foreclose the potentialities of their living time and energy, to the extent that they are precarious and without means of subsistence – that without the money given by the capitalist, they lack the means of reproducing their own life. The industrial proletariat forms only as people flock to cities from the countryside after being ripped out

[11] John Bellamy Foster, *Marx's Ecology: Materialism and Nature* (Monthly Review Press, 2000).
[12] Marx, *Capital, Vol. 1*, 638.

of relations with the earth, or with other social ecosystems, that could sustain them (expropriation of lands, or primitive accumulation). A "free" (in the sense of free-floating) flow of population meets a free (unencumbered and unqualified) flow of capital, ready to offer a wage where once the earth stood.

A major part of Marx's political reason for emphasizing the qualitative structure rather than the quantitative level of production in this context was to respond to Malthusian claims about overpopulation exceeding some allegedly fixed natural capacity of the earth (an argument we do well to remember today).[13] Marx held that, humans being a genuinely creative part of a genuinely creative nature capable of changing and producing the new, it is always at least in principle possible to develop and sustain the capacity to produce "enough"; that science, technology, and, above all, good planning would make it possible to reintegrate flows and use materials more wisely, thereby expanding rather than degrading the capacities of both humans and the earth. His ecological reflections are thus intimately related to the core of his political, historical, and even ontological commitments, and more than affirming any postulate of soil science it is the great achievement of Foster's iconoclastically orthodox exegesis to unearth the depth of these relations in exquisite detail. The concept of "rift" also has a deeper philosophical significance than perhaps meets the eye. It designates the fragmentation and subsequent incommensurability between parts of nature, or the alienation of elements that may have once been integrated into a functional whole. It involves first the differentiation and freeing of flows, but does not stop there; there is a crucial second step in which such flows are blocked from return to the integrated cycles that formerly served as their condition of reproduction. Stability and reproduction must then be composed on a

[13] Foster, *Marx's Ecology*, 87–104, 105–10, 142–44ff.

different and more abstract (or "higher") basis, operating on the articulated difference between freed flows and holding them together in a dynamic pattern which then seeks to reproduce itself autonomously (that is to say, indifferent to the uncertainties of particular fluxes).[14] If there is an intrinsic "logic" to capitalism's ecologically destructive tendencies, it would thus seem to be located at the moment when reproduction comes to depend on such fragmented and blocked relations.

It is this second moment that I will be returning to repeatedly, for this is also the moment of infrastructure, and captures something crucial about electrical infrastructures in particular. What is electricity if not a partial alienation from cycles of day and night, holding the intensity of energy consumption at a particular level? What is a grid if not a machine for abstracting and coordinating multiple uncertain flows into a single, smooth spacetime of reliable and uniform capacitation? *Anti-Oedipus*, it turns out, also robustly theorizes this dynamic. While both Marx and Deleuze/Guattari do hold that production is primary, and is indeed the proper name for the total social and perhaps even ontological process, they each differentiate this totality into moments of production proper (e.g., labor), distribution, consumption, and so forth.[15] Deleuze and Guattari capture this by speaking in terms of production of production, production of distribution, and production of consumption, in order to emphasize that each of these moments is both

[14] Examples: Nutrients are held apart and blocked from returning to the soil, requiring either the import of fertilizer from afar (which, beginning in the 1820s, led to a frantic hunt for and colonial extraction of guano) or the production of artificial fertilizers (an energy-intensive process that has played a historical role in the expansion of electrical generation capacity in the US and Germany; Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Johns Hopkins University Press, 1983), 288). Carbon molecules are released into and then accumulate in the air rather than feeding back into production, requiring new rounds of extraction to reproduce the patterns of energy consumption they have facilitated. And representations of labor time accumulate as exchange value away from laboring bodies, positing exchange value as an autonomous end of production incommensurate with the needs of those bodies, but on which the latter nevertheless come to depend.

[15] See Marx, *Grundrisse*, 88–100.

produced and productive. As I will discuss more fully later, they map these economic moments onto three "syntheses of desire," or three moments and types of relations that go into the formation of subjectivity. Thus, far from a flat ontology, their account presents a true ecology of relation, with different moments folded on top of, feeding, sustaining, and limiting each other. The moment that corresponds to the concept of the rift, and which they also place under the heading of (production of) distribution, is what Deleuze and Guattari call "disjunctive synthesis," or the second of their three syntheses. It follows the "connective" (production of production) stage, which deals with free, uncontrolled, and unaccounted-for flows, and contingent encounters between flows. In disjunctive synthesis, something (e.g., an excess or surplus) produced in these contingent encounters holds the flows in place and slips beneath them to appear as their conditioning ground. It is about the way that a particular distribution, blockage, and hanging-together of flows forms a kind of surface on which the productions and consumptions on either side of it are inscribed and made possible. It is also, as we will see, the moment in which it becomes possible to supplant and ignore the earth as this virtual conditioning ground – the moment, as it were, in which the castle in the air of an earth-alienated life reaches cruising altitude.

In focusing on the infrastructures that effect and sustain such disjunctive syntheses, my intention is not simply to suggest an alternate language of description for infrastructure, but also to pose a question for Deleuze and Guattari's project. The conceptual resources of *Anti-Oedipus* are clearly not limited to the celebration of free flows that has been its enduring and oversimplified legacy. And yet there is no denying the fact that this work was written as an affirmation of the exuberant politics and ethics of

a particular historical juncture: namely, the events of May 1968 in France. This was a moment in which something like communism felt imminently possible, and yet it was not the Communist party but an anarchic, spontaneous uprising of both workers and students that led the way. It was a moment in which it seemed to many that the articulation of communism had to *be* anarchist, in which the development of material wealth made the repressions of the Soviet Union appear spurious and outdated, and in which it therefore became possible to focus on questions of subjectivity, desire, and freedom in ways that had been closed before. Indeed, the anarchist position, from Marx's time and in the admittedly general way that I will consider it here, just is that the (material, relational, and subjective) resources necessary for communism already exist in the present, requiring no transitional stage (e.g., socialism). The same mood is expressed in a different context by American anarchist Murray Bookchin, who first published his classic *Post-Scarcity Anarchism* in 1971 (just one year before *Anti-Oedipus*). Bookchin takes the official Marxist parties of his day to task for remaining trapped within a 19th and early-20th century orientation toward problems of material necessity and scarcity, at precisely a moment in which technology had advanced to a point that could enable automation to replace unnecessary toil, and social desires had progressed to demand a rounded and freely developed life over mere survival. In Bookchin's view, "Marx was occupied above all with the *preconditions* of freedom (technological development, national unification, material abundance) rather than with the *conditions* of freedom (decentralization, the formation of communities, the human scale, direct democracy)."[16] As he makes clear, however, his issue is not so much with Marx's critique of the latter's own day as its inadequacy for the conditions of the 1960s: "The industrial capitalism of Marx's time

[16] Murray Bookchin, *Post-Scarcity Anarchism*, 2nd ed. (Montreal: Black Rose Books, 1986), 232.

organized its commodity relations around a prevailing system of material scarcity; the state capitalism of our time organizes its commodity relations around a prevailing system of material abundance. A century ago, scarcity had to be endured; today it has to be enforced," and for Bookchin it was the state that accomplished this function.[17] Following Soper, I have already argued that Marx was indeed sensitive to the dialectic of conditions and preconditions that Bookchin describes; nevertheless, Bookchin was perhaps right to be concerned by the narrow focus of the particular Marxist (and perhaps even more so, Leninist) imaginary of the movements that he viewed as holding back the specific revolutionary potentials of his time.

In this way, I read *Anti-Oedipus* as a fundamentally Marxist text, but responding to a different set of material conditions (as any Marxist text should). And in the same way, my question is thus how to read *Anti-Oedipus* post-1968, when a different set of concerns, responsibilities, and material conditions announce themselves. More precisely, if we situate this work retrospectively as the expression of a particular moment in a larger historical trajectory, how can we build on its framework for a critique of the present? Indeed, the question of communism (and recent inquiry into infrastructure, for that matter) seems constantly inscribed within a repetition of dates: why is it that we still continue to find ourselves either with Marx in 1848, Lenin in 1917, or Deleuze and Guattari (among others) in 1968? (In a North American context, we should also add the New Deal-era politics of the 1930s, perhaps the closest we ever came to Lenin.)[18] These

[17] Ibid., 59.

[18] The danger of remaining trapped within the imaginary of struggles past is in fact a major thrust of Bookchin's argument: "Once again the dead are walking in our midst – ironically, draped in the name of Marx, the man who tried to bury the dead of the nineteenth century. So the revolution of our own day can do nothing better than parody, in turn, the October Revolution of 1917 …" And he finds Marx himself, in his *Eighteenth Brumaire*, already complaining of the same thing: "And just when they seem to be engaged in revolutionizing themselves and things … they

are in no small part aesthetic worlds, circumscribed by particular emphases, possibilities, and limitations. While attempting to avoid becoming trapped within them, I will be repeatedly returning to these texts and dates – not simply to rehash their insights, but in order to set the movements and contradictions between them against the contradictions of the present, in the hope of arriving somewhere (however slightly) new.

I am not alone in thinking that the category of infrastructure has a particular manifest resonance for such questions in the contemporary moment. Dominic Boyer insightfully points out that the recent "infrastructural turn" in many areas of the humanities seems historically indexed to a resurgent nostalgia for the Keynesian public works and welfarism that buoyed many western countries from the mid-1930s to mid-1970s – an attempt at a kind of "conceptual New Deal for the human sciences."[19] This resurgence makes sense, he observes, given its emergence roughly in parallel with the 2008 financial crisis that shattered any illusions of stability for the post-Keynesian, laissez-faire neoliberal period, which has left all manner of public infrastructures tattered and starved. Yet Boyer is also skeptical of this nostalgia: following Timothy Mitchell, he argues that the Keynesian paradigm was tethered to a presupposition of growth that itself depended on cheap, apparently infinite oil, and "imperial control over the Middle East's

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anxiously conjure up the spirits of the past to their service and borrow from them names, battle slogans and costumes in order to present the new scene of world history in this time-honored disguise and borrowed language. Thus Luther donned the mask of the Apostle Paul, the revolution of 1789 to 1814 draped itself alternately as the Roman Republic and the Roman Empire, and the revolution of 1848 knew nothing better than to parody, in turn, 1789 and the tradition of 1793 to 1795 …" (quoted in ibid., 196–7). An endless repetition of repetitions.

[19] Dominic Boyer, "Infrastructure, Potential Energy, Revolution," in *The Promise of Infrastructure*, ed. Nikhil Anand, Akhil Gupta, and Hannah Appel (Duke University Press, 2018), 224. *Anti-Oedipus* was of course also born of (the tail end of) this Keynesian period of relatively distributed abundance, and the influence of Keynes on Deleuze's economic thought has been noted; see Daniel W. Smith, "Flow, Code and Stock: A Note on Deleuze's Political Philosophy," *Deleuze Studies* 5, supplement (2011): 36–55. According to Smith, Keynes was the source of the language of "flow" and "stock" that Deleuze and Guattari frequently employ.

oil resources … [by] the Anglo-American world and its allies." The material conditions that facilitated this paradigm are unlikely to return. Therefore, without giving up the optimistic spirit which the promise of public infrastructure invites, Boyer suggests that we view the recent turn as something wholly of the present, as part of a wider and thoroughgoing effort to rethink our place in nature in light of climate change, "a sign that we are conceptually re-arming ourselves for the struggle against the Anthropocene and the modernity that made it."[20]

It is here that solar-generated electricity becomes an especially interesting object to think with. For solar once again promises an immediate, inalienable, and free-flowing abundance, often premised on decentralization no less. David Schwartzman has argued that an economy premised on living within the abundant flux of solar energy on the earth's surface is a precondition for achieving the end to scarcity and the meeting of needs implied by Marx's conception of communism.[21] And yet, what happens if we orient toward conditions in which such abundance is already coming into play? As Bataille famously described, our relation with the sun inverts all economic principles that would begin from an assumption of scarcity: while lack may appear on the level of individuals, from the perspective of the total movement of energy through the biosphere, there is not just enough but too much.[22] Solar radiation creates an incessant pressure, an asymmetrical "gift without return," and the primary problem of such a general or solar economy is how to channel, distribute, and consume this excess. At first, it sustains the growth of systems (e.g., the meeting and expansion of individual needs), but ultimately it must be consumed

[20] Boyer, "Infrastructure, Potential Energy, Revolution," 226.

[21] David Schwartzman, "Solar Communism," *Science & Society* 60, no. 3 (1996): 307–31.

[22] Georges Bataille, *The Accursed Share, Vol. 1: Consumption*, trans. Robert Hurley (New York: Zone Books, 1991). See especially pp. 19–41.

beyond the realm of necessity, in a "luxurious" or "wasteful" expenditure that exceeds the individual and continues the general movement. Starting from the perspective of abundance and excess makes it possible to bracket or take for granted certain problems of the raw materials and energies of production (much as Bookchin did in starting from a post-scarcity technological condition). As the After Oil collective writes, a major promise of a condition of "solarity" is that "[w]ith solar power, we appear to have found a way to cut fuel out of the picture of energy production," to access "energy without mediation."[23] And yet, as they argue, if we are to harness such energy as a replacement for fossil fuels (e.g., in electricity production), this will necessarily insert it into many layers of infrastructural mediation. Such infrastructures complicate and crystallize pathways for the Bataillean channeling of excess, which must therefore be thought not only from the side of acts of consumption, but from that of systems and relations of distribution as well. Following Marx and Deleuze/Guattari, distribution does not mean simply the distribution of articles of consumption, but the whole hanging-together, integration, or fragmentation of the milieu in which production as a processual totality takes place. It is a matter of the mediation between flux and stasis, of what holds them together and apart.[24]

If these are the themes about which energy infrastructures invite us to think, then the latter also provide an opening onto broader questions that might be put to the communist or anarcho-communist position today. What are the possible relationships

[23] After Oil, "Solarity: Energy and Society After Oil; An Introduction to *Solarity: After Oil School II*." (2019). http://afteroil.ca/solarity/solarity-syllabus/.

[24] In this way, I am not suggesting that distribution be taken as primary over production, in the Lasallean sense that Marx warns against in the *Critique of the Gotha Programme* (pp. 81–91). On the contrary, following Deleuze and Guattari, distribution for me will always be a secondary moment, and what is decisive about it is the way that it conditions new rounds of production. If I appear to give distribution a certain primacy in this study, it is only to orient analysis toward problems of abundance in the Bataillean sense.

between free becoming, material abundance, and the infrastructural stability necessitated by something like a planned economy? Are there possible good (or at least non-detrimental) forms of stasis? It is not enough today to assert that rupture is possible: if the conditions for a different ecology of relations are already close at hand, it is worth looking for their possible principle of operation as well. Bookchin says it well: "What the French 'masses' lacked [in May '68] was not a central committee or a Lenin to 'organize' or 'command' them, but the conviction that they could have *operated* the factories instead of merely occupying them."[25] In the hope of bolstering such conviction, I proceed with the same sense of cautious optimism that Boyer evokes.

Here then is the plan. Part I orients around a case of relative general wealth and literal solar energy abundance: California's electricity grid, especially from the late 1990s to the present. Drawing on *Anti-Oedipus*, I show how the desire to hold the inherent uncertainty and intermittency of solar energy at bay drives chains of infrastructural mediation to create stasis out of flux, and thereby furthers a rift, disjunction, or alienation from the earth by insulating us from its rhythms. I argue that the presubjective structures of desire described by Deleuze and Guattari capture something important about the way that desire, subjectivity, and social practice sit within an infrastructural system like an electrical grid, yet are also held apart and alienated from meaningful participation in such systems. The difficulty in imagining that particular energy sources give rise to particular social, political, and cultural forms is that these sources are not typically desired or imaginatively invested as such; even the electricity they are used to generate is only an indirect means to various ends, held as far as possible from consciousness by many layers of infrastructural mediation (some of which are no doubt psychological). Thus, I argue

[25] Bookchin, *Post-Scarcity Anarchism*, 238.

that attending to the dynamics of such infrastructures of distribution and mediation, rather than simply a difference between energy sources, reveals a more nuanced set of challenges that must be overcome if a technology like solar electricity is to avoid reproducing capitalist economic and ecological relations. Part II takes up the concept of planning as a possible response to these challenges. If capital resists planning, thriving on the free development of uncertain flows, what kind of planning could achieve and sustain abundance without specifying everything in advance, leaving room for uncertainty without making us precarious all the way to the foundations and supports of our being? It is ultimately in Harney and Moten's *The Undercommons* that I find the outlines of an answer.

Parmenides may well be the patron saint of a fuller inquiry into the concept of energy. For the present and more limited investigation, however, I would invoke a different name: Epicurus. The subject of Marx's doctoral dissertation, the Epicurean conception of nature remained a prominent influence on all of Marx's subsequent thought, as Foster richly demonstrates.[26] This was a picture of reality that turned on the distinction between an unchanging, indestructible power of the materials (atoms) that make up the world, and the manifold complex structures that are composed out of combinations of these seeds of existence. Epicurus is perhaps best known today for his concept of the *clinamen* or "swerve" that introduces a degree of chance and uncertainty into the world. Yet he was also sensitive to the fact that uncertainty does not equate to freedom. Rather, by prying open a gap within the realm of determinacy and necessity, uncertainty is more like an infrastructural substrate that makes both determination and freedom possible. Moreover, while Epicurus is often associated with a pure and

[26] See Foster, *Marx's Ecology*, 2–6, 32–65.

unrestricted hedonism, he in fact had a nuanced critique of needs and the pleasures to be gained from them. On his view, the good life was to be attained in part by understanding that the resources to meet one's true needs are very often close at hand. For his dialectic of chance, necessity, and freedom, Epicurus perhaps lingers behind much of what will be written here. There is a final reason I mention this name, however. Epicurus is sometimes claimed today on one side of a division in the meaning of a philosophy of "materialism," which is often also inscribed as a division between Marx and Deleuze. But these philosophical lineages do not separate as cleanly as some would like, and here I forthrightly hope to make such a division unworkable. In light of the present convergence of crises, it seems to me time to forge new alliances and leave behind old tensions that have long since gone slack. With Marx, however, I affirm that this can only be done by working through the real contradictions, rifts, and disjunctions of the present.

Part I
May the Sun Never Set on this Plateau: Excess, Intermittency, and Flow on the California Grid

"It is at work everywhere, functioning smoothly at times, at other times in fits and starts …"
– Deleuze and Guattari, *Anti-Oedipus*

"In California water flows uphill toward money."
– Kim Stanley Robinson, *Pacific Edge*

Electricity: our terrestrial Sun. Though polyvalent, this formula is not a metaphor so much as a monstrous material parody.[27] A descent and division, a grounding, the diversion of a flow. Long before solar irradiance could be harnessed directly to generate it, electricity was issued as a Promethean challenge to the sun. As historian David Nye relates, one of the earliest imagined promises of the technology was the abolition of night: at the dawn of electrification in the late 19th century United States, the nocturnal disappearance of the sun came to be seen by some as a "check on human freedom" and productivity.[28] Constant light would be a gift to agriculture, leading to "corn large enough to harvest with saws." The electrified night was not simply a human addition to the natural environment, but "an illusory landscape that erased the distinction between the natural and man-made … an impossible middle realm between nature and culture."[29] Insulated from the most basic earthly rhythms, untethered from historical cruelty and limitation, this new and improved sun would deliver endless abundance and liberation to the perceived blank page of the American continent.

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[27] On parody, cf. Georges Bataille, "The Solar Anus," in *Visions of Excess: Selected Writings, 1927-1939*, trans. Allan Stoekl, Carl R. Lovitt, and Donald M. Leslie Jr. (University of Minnesota Press, 1985).

[28] David E. Nye, *Electrifying America: Social Meanings of a New Technology, 1880-1940* (MIT Press, 1992), 150. The quote is from J.B.S. Haldane, noted Marxist biologist and commentator on Engels' *Dialectics of Nature*; clearly, then, the complaint was not limited to the capitalist imaginary.

[29] Ibid., 3, 390.

From the beginning, then, electrical infrastructures were in part about filling gaps left by the sun. In a dialectical irony, these same gaps now return to puncture the smooth uninterrupted supply of electricity, at a moment when the system has grown to consume so many terrestrial resources that seemingly only the sun itself can power it into the future. This is commonly known as the problem of intermittency in renewable energy systems. It highlights the well-worn fact that all energy on earth is ultimately of solar origin, distinguished only by proximity and what Andreas Malm calls "spatiotemporal profile" in relation to the sun.[30] Fossil fuels, the result of dead organic matter once fed by photosynthesis, condensed and solidified by time, pressure, and heat, can easily be broken up, shipped anywhere, and burned at will – composing what Malm calls an "abstract" spacetime, since the rhythm of consumption is independent of other natural processes. Sources like solar and wind, by contrast, tap more directly into the mainline of undomesticated flows produced by the sun, and are dependent on its rhythms and fluctuations.[31] It is common within multiple literatures on energy economy to designate the first of these profiles "stock" and the second "flow." The difference between them has decisive implications for electrical systems in that electricity remains very difficult to store in quantities sufficient to meet the demands of an industrialized society; instead, electricity is a paragon of just-in-time production, transmitted through cables at 80-90% of the speed of light. Because production must be matched to demand in real time, the functioning of this industry, and therefore of social formations dependent upon it, relies heavily upon effective forecasting and coordination of many moving parts.

[30] Andreas Malm, *Fossil Capital* (Verso, 2016), 38–42.

[31] Wind is caused by complex interactions of atmospheric pressure gradients and the rotation of the earth (*inter alia*), both of which are attributable to the sun as heat and gravity.

Thus, transitions toward intermittent sources make evident that energy problems are always already problems of information as well (specifically: planning, prediction, and control), in ways that have not typically received sustained attention in recent scholarship on social, cultural, and political dimensions of energy. Part II will take up these informational aspects more explicitly. Here, however, I aim to assemble the ground out of which these problems emerge, and the way the above themes converge in concrete problems facing energy transitions today. At the same time, my intention in what follows is to raise the philosophical stakes, and the level of abstraction, of thinking about energy infrastructure, solarity, and political economy. Concepts of stock and flow are too often thought simply in terms of energy *sources*, and as alternatives to one another, without posing the problem of how these patterns move, produce, and enable each other across a general economy and ecology. How is stasis produced out of flux and uncertainty, holding us apart from any encounter with what such invariance and reliability is composed of? Electricity poses this problem on both phenomenological and political-economic levels. But, going further, what binds these threads together, sustains their relations over time, and gives form to their articulation within a particular historical context? The usual models of determination fall short here. We know by now that this can never be a matter only of natural, logical, or technological imperatives; recent turns toward "materiality" have also emphasized the explanatory limits of social (and especially linguaform) meaning and practice. But it is even less satisfying to rest analysis on the description of a purely contingent assemblage, or on the claim that in some unspecified way all of these factors are mutually co-determining. Infrastructures like electricity invite difficult questions about the role of social meaning and practice in

technology, precisely because they articulate differences between factors that do not all have the same principles of functioning. Such systems demarcate spheres of consciousness and forgetting, and moreover determine certain spheres as apparently imperturbable by social meaning and practice. Indeed, what to do with the fact that it is (often, not always) the very phenomenal nature of these infrastructures to disappear into the background, to be relied upon and at the same time disavowed as a site of investment of attention, meaning, action, and desire? Many fruitful studies of infrastructure have responded to this problem by focusing on moments and contexts in which a system becomes visible upon breaking down, cases that perhaps negatively demonstrate social investments by showing what floods in and becomes possible in such moments of interruption. Here, however, I want to tarry with what might be called the positive moment of infrastructure, when the thing basically works (which might equally be called the negative moment if considered from the side of social disavowal). How to make sense of a collective investment in forgetting – in obliviating intermittency, and thereby enabling forgetting of what enables us?

Here I argue that a careful reading of Deleuze and Guattari's *Anti-Oedipus*, which at its heart deals with a rethinking of social investments of desire in relation to political economy, can help make sense of these questions in surprising and powerful ways. Moving beyond immediate questions of the effects of different energy sources, my claim is that something goes on in *Anti-Oedipus* in the shift from the moment of production to that of distribution that is of vital consequence for theorizing infrastructure, and perhaps energy infrastructure in particular. Moreover, their project presents a theory of flows, and the channeling and distribution of flows, that bears the clear influence of Bataille and

offers important insights for literal solar economy. Of critical interest to me here is the way that, as Deleuze and Guattari describe, capitalism thrives on breaking and segmenting flows, organizing and distributing lack amidst generalized overabundance. "Flows, who doesn't desire flows, and relationships between flows, and breaks in flows? – all of which capitalism was able to mobilize and break under these hitherto unknown conditions of money."[32] If this is true, to what extent should we expect capitalism, of all things, to be fazed by what Malm and many others have suggested is the energetic imperative of our time, and the great promise of solar power: a "return to the flow"?[33] Efforts to wire our economic metabolisms to the sun will have to contend with and emerge from this problematic.

My point of departure for parsing this dense web is the recent history of California's electrical economy. I begin and end with the present moment, passing in between to its origins in a longer history of energy development in the region. Part II will expand upon the California electricity crisis period between the late 1990s and 2001 that also contributed strongly to some of the trends discussed. The exposition is thus thematic rather than chronological, and the theoretical discussion is interwoven and foregrounded throughout. Far richer empirical histories of electricity and solar generation in California are already extant,[34] and this study builds upon that work to attempt to orient a

[32] Gilles Deleuze and Félix Guattari, *Anti-Oedipus*, trans. Robert Hurley, Mark Seem, and Helen R. Lane (Penguin Books, 1977), 229. Subsequent citations will abbreviate this work as *AO*.

[33] Malm, *Fossil Capital*, 367ff. Such a return would perhaps be, as Schwartzman puts it, a "negation of the negation," undoing the turn away from living within the preindustrial solar flux that fossil fuels made possible. Schwartzman, "Solar Communism," 322.

[34] See in particular: Shane Brennan, "Practices of Sunlight: Visual and Cultural Politics of Solar Energy in the United States" (PhD diss., New York University, 2017), 117–189; Christopher E. Johnson, "'Turn on the Sunshine': A History of the Solar Future" (PhD diss., University of Washington, 2015); Thomas P. Hughes, "California White Coal," in *Networks of Power*, 262–84; James L. Sweeney, *The California Electricity Crisis* (Hoover Institution Press, 2002). This study is also indebted to scrupulous journalism by Ivan Penn for the *Los Angeles Times* and David Roberts for *Vox*.

conversation around themes that are properly translocal.[35] I draw upon a particular history above all to make these themes, the interconnection of which could otherwise seem abstractly contrived, concrete. Nevertheless, choice of place matters: not only does California, a wealthy region in the global north, present for the most part (with the notable exception of 2000-2001) an example of what I call the positive moment of infrastructure, but there the technical, ecological, and (to a comparatively significant extent) political capacity for a substantially solar-based energy economy are within reach. That there are barriers even here, and at times shockingly absurd ones, makes this perhaps a cautionary tale – a tragedy of the best of possible worlds.

Oedipus electric: The paranoid infrastructures of utopia

Solar flows beat down everywhere, but not everywhere and always the same. California is perhaps especially inundated. Flows of sunlight, flows of electric current, flows of capital; flows of population, code, and information; flows of desire liberated; flows decoded and made uncertain, full of speculative potential. *It's May '68 in the desert, but capital is the order of the day*. Since its colonization by Europeans and their descendants, California has been haloed by rumors of abundance: gold, lands, oil, sunshine – a utopia cleared for the taking, however violently.

Today, the Golden State finds itself facing an energy glut. While electricity demand has stagnated and even fallen slightly since consumers began cutting back during the global economic crisis of 2008, the state has continued to expand generation capacity

[35] As anthropologists Winther and Wilhite put it, electrical lines are "tentacles of modernity" that are crucial for understanding a historical condition of increased "translocal interconnectedness." Tanja Winther and Harold Wilhite, "Tentacles of Modernity: Why Electricity Needs Anthropology," *Cultural Anthropology* 30, no. 4 (2015): 569–77.

at a remarkable rate. In many ways, its energy position is unthinkably enviable for much of the world, even its more electrically developed corners: public environmental consciousness is relatively high compared to the rest of the US, and much of the new excess of power is driven by aggressive expansion of renewables, led by a mix of government, industry, and independent citizen investments and initiatives. Utility-scale solar generation – comprising both photovoltaic (PV) and solar thermal (concentrated solar power, or CSP) technology – has increased particularly dramatically, from meeting less than 0.5% of total power demand in 2010 to almost 12% in 2017, with rooftop PV panel installations adding approximately another 4%.[36] These gains are made possible by relatively high levels of insolation of the region, combined with large tracts of unsettled desert land especially ripe for utility-scale solar installations. Indeed, the material conditions are so fortuitous that California has been variously referred to as a solar "gold mine" and "the Saudi Arabia of solar." If solar can work anywhere, it should work here: as former governor Arnold Schwarzenegger once declared in exasperation, "If we cannot put solar power plants in the Mojave Desert, I don't know where the hell we can put [them]."[37] But solar development has also been spurred on by consistently ambitious government initiatives in clean energy. First enacted in 2002, California's Renewables Portfolio Standard (RPS) initially mandated that 20% of electricity demand be served by renewable sources by 2017, but has been repeatedly accelerated (in 2006, 2011, 2015, and 2018) as targets have been surpassed ahead of schedule. The most recent mandate

[36] "California Solar Energy Statistics & Data." n.d. Accessed February 20, 2019. https://www.energy.ca.gov/almanac/renewables_data/solar/; Ivan Penn, "California Invested Heavily in Solar Power. Now There's So Much That Other States Are Sometimes Paid to Take It," *Los Angeles Times*, June 22, 2017.

[37] Quoted in Brennan, "Practices of Sunlight," 117. The preceding descriptions of California's solar potential are quoted in ibid., 124–5.

has accelerated the RPS to 60% renewable energy on the grid by 2030, and requires 100% carbon-free electricity by 2045.[38] This directive was signed into law in September 2018, just weeks before the IPCC special report outlining the need for global carbon emissions to fall 45% by 2030, and reach net zero by 2050, in order to limit warming to 1.5°C above preindustrial levels.[39]

However, the state government has simultaneously continued to subsidize construction of new fossil fuel plants (coal and natural gas).[40] Going well beyond meeting new and expected demand, this capacity is knowingly redundant, aimed at shoring up the reliability of the grid and ensuring that there are no gaps in the available supply of electricity. Some measure of redundancy is standard and nearly universal to the electric industry, and some of California's surplus is also a response to the inherent intermittency introduced by the enormous amounts of renewable sources coming onto the grid. But this hypertrophy is also in part a paranoid political reaction in the aftermath of past trauma. In 1998, California deregulated electricity production and opened it to market competition, in an attempt to break the monopoly power of its three major investor-owned utility companies, which together serve approximately 75% of the state's total power. This

[38] The goal of completely decarbonized electricity by 2045 is technically separate from and broader than the RPS update. Although the bill (SB 100) stipulates 60% renewable energy by 2030, it is designed so that progress toward net zero beyond this point can be flexible enough to include gains from more controversial sources such as large hydroelectric and nuclear, and/or carbon capture that would offset some continued use of fossil fuels such as natural gas. The bill also does not specifically address transportation, which remains a major source of carbon emissions; however, California's growing electric vehicles market means that decarbonizing the grid is likely to increasingly mean decarbonizing transportation as well. See David Roberts, "California Just Adopted Its Boldest Energy Target Yet: 100% Clean Electricity," *Vox*, August 31, 2018.

[39] "Global Warming of 1.5°C" (Intergovernmental Panel on Climate Change, October 8, 2018), https://www.ipcc.ch/sr15/.

[40] This is consistent with global trends, where state subsidies for fossil fuels are a major reason that the latter continue to be cheaper than renewable sources in most regions. Malm, *Fossil Capital*, 369.

opened the door to increased financial speculation and market manipulation by energy trading corporations such as Enron, resulting in massive shortages and rolling blackouts in 2000-2001. By this point, utilities (and state and local governments) had little ability to intervene directly in the supply, as they had already sold off most of their actual generating plants. Under pressure to avoid any possible repeat of this scenario (which is widely seen as a major factor leading to the 2003 electoral recall of California governor Gray Davis), but also facing pressure from the power industry to stay the course on deregulation, lawmakers have navigated this impasse by investing heavily in new generation capacity. According to one engineer and consumer advocate, "They are needlessly trying to attain a level of reliability that is a worst-case 'act of God standard.'" All told, California now stands poised to produce at least 21% more power than it needs by 2020 from utilities alone (i.e., not counting rooftop panels). State regulations require a 15% redundancy, though some industry analysts argue that 10% is generally adequate.[41]

This strategy of massive redundancy means that solar generation is always shut down first in times of excess production, because it is cheaper and quicker to turn on and off than fossil fuel plants, which require a much longer ramping time. In other words, California burns fossil fuels that could already be replaced by existing solar capacity, even when the sun is shining, and is likely to continue to do so well into the future. Just recently, in June 2019, California set two new records for itself: "the most solar power ever flowing on the state's main electric grid, and the most solar power ever taken offline because it wasn't needed."[42] Moreover, despite falling demand, a massive increase in

[41] Ivan Penn and Ryan Menezes, "Californians Are Paying Billions for Power They Don't Need," *Los Angeles Times*, February 5, 2017.

[42] Sammy Roth, "California Has Too Much Solar Power. That Might Be Good for Ratepayers," *Los Angeles Times*, June 5, 2019.

supply, and a rapid decrease in the price of solar as the technology has become more commonplace, the consumer price of electricity in California has actually increased, with the gap between what residents of the state pay compared to the rest of the US doubling in recent years to about 50%. One reason for this is the form that subsidies for the construction of new power plants take:

> Utilities are typically guaranteed a rate of return of about 10.5% for the cost of each new plant regardless of need. This creates a major incentive to keep construction going: Utilities can make more money building new plants than by buying and reselling readily available electricity from existing plants run by competitors.[43]

Even though it takes time for returns on these investments to be realized, they are effectively insulated from the risks of the market, as the rate of return is fixed from the moment the contract to build is signed. And these costs are passed off directly to consumers, irrespective of actual demand: "Once state regulators approve new plants or transmission lines, the cost is now built into the amount that the utility can charge electricity users — no matter how much or how little it is used."[44] Another factor contributing to inflated costs has to do with the redundancy strategy itself, exacerbated by the daily rhythms of solar. Generation levels cannot be allowed to fall below demand, at risk of blackouts; however, overloads of current can severely damage transmission systems, also resulting in blackouts. In California, the current solution to this problem is to overgenerate and find somewhere to channel the excess. Especially during times of peak solar production (i.e., the middle of the day), utilities will sell excess power to neighboring states such as Arizona. But it is often the case that Arizona, having made its own significant investments in solar, does not actually need this overflow, as its solar

[43] Penn and Menezes, "Californians Are Paying Billions for Power They Don't Need."
[44] Penn, "California Invested Heavily in Solar Power."

facilities are peaking simultaneously. In these cases, California will sometimes *pay* Arizona to take their power, since Arizona must bear the costs of halting their own production to absorb it (and, of course, Arizona will curtail their own solar before fossil plants).[45] Costs from these two factors, totaling billions and millions of dollars respectively, may work to mask the economic benefits of solar to the populace at large, thereby sowing ambivalence about energy transition and providing ways for entrenched energy powers to barricade themselves from mounting industry sea changes.

The keystone holding these absurdities in place, at work across the otherwise divergent interests of society, government, and industry, is the desire to avoid intermittency at all costs. It traverses these spheres as a common assumption, suffusing the social-technical-economic field like a gas. But what is at stake in conceptualizing this as a matter of desire, and where precisely to locate desire in the scheme of infrastructural technics and economics? Again, one approach to understanding this relation is to orient toward moods and moments when infrastructures are not so invisible after all. As Brian Larkin argues, whether through spectacular demonstrations or through affective associations of progress, modernity, and futurity,

> infrastructures also exist as forms separate from their purely technical functioning, and they need to be analyzed as concrete semiotic and aesthetic vehicles oriented to addressees. They emerge out of and store within them forms of desire and fantasy and can take on fetish-like aspects that sometimes can be wholly autonomous from their technical function.[46]

This is no doubt true, and useful if one's investigation is confined to the aesthetic and hermeneutic as an autonomous sphere. Here, however, I am pointing to a way in which things like investments of desire, fetish, fear, and paranoia form *part* of the technical,

[45] Ibid.

[46] Brian Larkin, "The Politics and Poetics of Infrastructure," *Annual Review of Anthropology* 42, no. 1 (2013): 329.

political, and economic functioning of the infrastructure itself. Lest it appear that my explananda are ultimately the workings of a technical machine, we can immediately turn the question around: Where are *infrastructures* located? Larkin clearly recognizes that there is a problem here, arguing that infrastructures have a "peculiar ontology" in that they are "things and also the relation between things." Yet by "relation" he seems to have in mind primarily physical interconnections between points that "enable the movement of other matter"; in other words, still a thing. Foregrounding relation itself means going beyond bare connection to ask what *kinds* of relations are involved in infrastructural being, something Larkin begins to thematize with the notion of "enablement," or creating "the grounds on which other objects operate." For him, this along with their "systemic" quality is what distinguishes infrastructures from other technologies. But surely every tool enables, and organizes its own ground and the ground for further action; this was already Heidegger's concept of the ready-to-hand. Rather, infrastructural relation seems to involve more from time and subjectivity. Infrastructures cannot be thought on the model of a momentary utterance directed at an addressee, but involve something sustained and repeated. They are about the point at which enablement passes over into (relative) dependence, in the sense of an addictive habit even, which is subject-constituting; i.e., without which a subject (or subject-effect) cannot be what it is. As Nye puts it, "People do not merely use electricity. Rather, the self and the electrified world have intertwined."[47] Subjectivity is part of the infrastructure, and infrastructure is partially located in subjects or processes of subjectification.

But this requires clarification, not least because I have emphasized the importance of the fact that certain infrastructures involve subjective disavowal, distancing, and

[47] Nye, *Electrifying America*, 390.

alienation as an intrinsic feature. In other words, the kinds of desire and subjectivity I have in mind here are not limited to individuals and subject positions, because infrastructures like electricity are, in moments of backgrounding and invisibility, precisely not deep wells of "meaning" in the way that we in the humanities tend to read for. What kind of desire is it that disavows itself, and perhaps even disavows and works against its subject? Malm treads into this territory when he asks why fossil fuel consumption remains so firmly entrenched in our lives despite most of us knowing better. Why do people not rebel and cast it off? He suggests a reading of fossil burning along the lines of an Althusserian Ideological State Apparatus (ISA), such that practices of fuel consumption interpellate subjects who, in being constituted by such practices, risk losing their very being in giving them up.[48] Like Althusser, Malm emphasizes that the sense of "ideology" at work here is not primarily about forms of consciousness, but material praxis. He points to the diffuse nature of fossil practices – "filling up a car at the petrol station, purchasing a ticket for a flight to some distant beach (or academic conference, or activist gathering), enjoying exotic fruits shipped in from some antipode, buying an iPad produced in China or simply paying the utility bill" – as representing a step beyond Althusser's ISAs, which are supposed to be distinct institutional spheres involving interactions between humans rather than with commodities. But he quickly reterritorializes this opening-out that is at work in economic relations onto the confines of distinct, bounded subjects. On this basis, he concludes that consumption is a dead end for climate politics; because he takes consumption in a purely individual sense, he then correctly points out that a politics addressed to individual consumer choices accords potential for change "in direct proportion to purchasing power," and by definition the

[48] Malm, *Fossil Capital*, 362–6.

wealthiest members of a fossil-capitalist society are "the subjects most thoroughly constituted by fossil use-values and therefore resistant to climate change mitigation." In any case, he reassures, consumption is ultimately subordinate to production, the "active moment" of economy. But has Malm really answered the question he began with? He asks why subjects behave against their interests, and answers by showing that in fact it is in the interests of some. But the field of investments of desire in electricity, perhaps even more so than in fossil fuels (though I would argue there also), seems to be wider and not quite as class-differentiated as this picture suggests; indeed, as I will discuss below, a kind of leveling or redistributive effect in this regard is a distinct part of its history. So, what goes on in this expanded field? Are people simply being duped by external forces exploiting them along with the earth's resources? Yes and no.

These are perfect waters in which to enter the stream of *Anti-Oedipus*. To begin with, Deleuze and Guattari are keenly attuned to the relation between consumption and subjectivity. For them, as in Malm's formulation, consumption is indeed the point at which a subjectivity flickers into being that does not exist prior, a subjectivity produced as a moment of enjoyment; if sufficiently repeated, such that a full-fledged subject begins to emerge, this enjoyment crosses over into the identification of enjoyment with a specific source (becoming a need or fetish). Where they break from the Althusserian scheme is (following psychoanalysis) in positing a host of ever-flowing presubjective desires and drives: something must already exist to be called to order in interpellation. This is why, although Althusser's reworking of ideology as material praxis comes very close to their own framework, they reject the notion that desire is a matter of ideology at all, and claim instead that "desire is a part of the infrastructure."[49] With this schema, they

[49] *AO*, 104.

short-circuit the distance between the Freudian unconscious and the Marxian mode of production; though the two are not necessarily isomorphic, they are internally structured by the same types of syntheses, and sutured together at multiple points. The result: that "the social field is immediately invested by desire"[50]; that desire is both produced and productive; that desire is structured in ways that, while not by any means necessarily random, may have nothing to do with the "interests" of a class-defined subject position; that social systems do not simply conjure subjects to serve and reproduce them, but operate through positive libidinal investments that are structured so as to immanently desire the reproduction of a social field, even against the "interest" of a subject who desires.[51]

Though Deleuze and Guattari are not here referring to infrastructure in the sense of technical systems, their framework seems to me to provide a better answer to the question of where to locate desire in technical infrastructures (and vice versa) than the alternatives discussed above, especially if we are trying to push on the profoundly unsexy, positive moment of infrastructure, when the thing functions smoothly and disappears. Here Deleuze and Guattari have the precise virtue of adding sex into the mix, and not simply for rhetorical effect. Consider the following observation: "Without electricity, couples cannot listen to the radio, play the stereo, or watch television, *and usually the birth rate temporarily soars nine months later*. Power failures reveal

[50] *AO*, 29.

[51] "Desire of the most disadvantaged creature will invest with all its strength, irrespective of any economic understanding or lack of it, the capitalist social field as a whole." *AO*, 229. "A form of social production and reproduction, along with its economic and financial mechanisms, its political formations, and so on, can be desired as such, in whole or in part, independently of the interests of the desiring-subject. It was not by means of a metaphor, even a paternal metaphor, that Hitler was able to arouse the fascists. It is not by means of a metaphor that a banking or stock-market transaction, a claim, a coupon, a credit, is able to arouse people who are not necessarily bankers." *AO*, 104.

electricity to be an integral part of the way we live" (emphasis added).[52] Do boredom and lack then stimulate desire, called forth in the negative? Perhaps. But following *AO*, we can turn this around to pose another question: *Where does the current of libido flow when the lights are on?* In other words, what positive, unconscious, presubjective investments of desire are at work in electrified life? More importantly, how do they work, and to what effect? What is their relationship to a mode of production – not simply as a reflection of it, but as part of the productive machinery?

Because they are so subjectively thin, it is not hard to discern *what* these investments are; a rich hermeneutic in the usual sense would be inappropriate here. Rather, they function in an extremely diffuse and abstract manner, because electricity is not consumed directly but rather through countless other tools and appliances – a kind of general equivalent for energetic enablement.[53] Electricity produces production and enjoyment indirectly through the production of more or less uniformly capacitated spaces and times (e.g., bringing sun-like light indoors, and into the night). It is an example par excellence of the concept of passive synthesis that Deleuze and Guattari take over from Husserl and Kant: the way that a world coheres behind our backs, at the minimum limit of contribution from intentionality or ego.[54] When it works and has been in place for

[52] Nye, *Electrifying America*, 388.

[53] In fact, Thomas Edison and Henry Ford once proposed "a new dollar standard based on electrical energy," due in part it seems to the recognition that electricity confused traditional categorizations of elements in the production process, at times substituting for labor, capital, raw materials, and instruments of labor (ibid., 234). Today, blockchain applications like Bitcoin that operate on a proof-of-work model also effectively use electricity as a form of capital, insofar as access to cheap electricity tends to be the chief barrier to currency mining rather than access to computing power per se.

[54] Cf. Mike Anusas and Tim Ingold, "The Charge against Electricity," *Cultural Anthropology* 30, no. 4 (2015): 546: "[E]lectric current does not draw attention to itself. The live wire gives no hint of the charge it carries. Electricity is treacherous, deceitful. Thanks to its sensorial subtlety, it can hold us fast within the grid without our knowing. And precisely because electricity is so insensible, it is hard if not impossible for consumers to trace its currents."

some time, no one loves electricity directly, but we love our lights, computers, machine-produced goods, etc. And much less is it the case that an energy source used in generation (whether fossil fuel or direct solar capture), placed even further out from consumption, enters into that moment in a direct, subject-constituting way, as Malm's account might suggest. Rather, it is here that Deleuze and Guattari's concept of disjunctive synthesis can shed some light.

Anti-Oedipus is structured around the repetition of three syntheses of desire – connective, disjunctive, and conjunctive – which are mapped onto the economic moments of production, distribution, and consumption, respectively. These syntheses are then remapped onto modes of social organization: a "territorial" formation (sometimes aligned with what is traditionally called "primitive communism"), a despotic imperial formation, and capitalism.[55] This second mapping is more complex because it is not one-to-one but multiplicative (in fact many times over, replicated at the level of intra-society groups, individuals, and parts of individuals). Thus, a concrete historical formation is distinguished not by the presence of one synthesis to the exclusion of others, but by the particular manner in which all three syntheses are structured and folded on top of each other, producing a certain geometry of desire composed of tensions, relays, and thresholds – enabling, interrupting, and holding each other back. The first, connective synthesis is about contingent assemblage: connecting one machine to another, introducing diversions and breaks in material flows; the third, conjunctive synthesis, is

[55] These "stages," traditionally referred to as "savagery," "barbarism," and "civilization," have a long history stretching back through Tylor to Montesquieu, but by most accounts Marx and Engel's proximate source was the American anthropologist Lewis H. Morgan, whose ideas about "primitive communism" were derived from his ethnographic studies of Haudenosee sociopolitical structure. Thus North American indigenous societies appear to have had a close, albeit indirect, influence on Marx and Engel's concept of what communism could be, at least in its precapitalist or preindustrial form.

what maps consumption onto subjectivity, as explained above. But in the middle, disjunctive synthesis (or production of distribution) is what holds the other two in a distinct pattern. This is why it is so useful for thinking infrastructure. As Lamarre argues, many studies of infrastructure (and, I would add, technology writ large) tend to emphasize "production (connective synthesis), or to assume subjectivity all the way down (conjunctive synthesis)," thus focusing on parallel streams of technical or psychosocial continuities. Disjunctive synthesis, however, is about what binds these streams, "holding them together across an interval."[56]

The moment of disjunction is perhaps most easily explained through the classic example that Deleuze and Guattari give in their critique of psychoanalysis. A baby's mouth is contingently coupled to a breast: does the breast already signify the whole person, "mother," as a *telos* which preorganizes all subsequent flows of desire? For Deleuze and Guattari, this identification of the part with a signified whole can occur only later, in conjunctive synthesis. The material connections between parts are always primary, and these only retroactively appear to be destined to hold in a certain pattern of organization. In making the Oedipus complex the cause of all routings of desire, psychoanalysis thus posits an after-effect as primary. But Deleuze and Guattari are not claiming that such organizations never occur (e.g., that certain persons never become privileged objects in the routing of desire[57]); rather, they are arguing that they do not have to occur, and thus offering an alternative explanation for such effects when they do occur (an explanation not premised on the symbolic representations characteristic of psychoanalysis, but modeled after a Marxian materialist reading of history). In order for

[56] Thomas Lamarre, *The Anime Ecology* (Duke University Press, 2018), 16–17.
[57] See *AO*, 47–8.

the flows of parts to form a distinct mode of production/organization, a kind of abstract surface must appear on which the distribution of parts is registered or recorded. The baby's mouth detaches from the local mouth-breast machine and becomes a generalized or abstract sucking-machine, plugging this or that into itself indifferently (one of the meanings of disjunction here is the "or" operator of formal logic). In the same way, the abstractions of value and capital enable passage between otherwise incomparable qualities by means of a common measure, such that every commodity appears as a tiny sum broken off from the great mass of social wealth, and it becomes possible to speak of a social distribution of wealth in general. And electricity operates in a similar manner, on the sides of both consumption and production. It transforms into this, *or* that, *or* that, breaking off little machines of enjoyment from a stockpile of not-yet-differentiated potentiation. It is what passes and enables passage through these series of machines: it becomes a kitchen light, then a coffee-grinder, then the heating element of a stovetop; a plugging machine becomes a computing machine becomes a writing-late-into-the-night machine. The grid itself feeds in electric current from this or that source, produced under this or that relation, and outputs to this or that appliance, under this or that form of ownership. Those who live on the other side of this great abstraction (further abstracted by the veil of the commodity relation) know even less about the particulars – their libidos, enjoyments, and life-rhythms connected directly to the abstract moment as such, which does all it can to overlay and smooth over any temporal-material variegation or intermittency. That is, until factors intervene to disturb the uniformity of this anti-rhythm, posing a problem for social desire and an opportunity for capital if it can solve it.

Deleuze and Guattari use several different figures to describe this not-yet-differentiated surface of abstraction. It is a body without organs: a whole that is not separate from its parts, and is completely produced by them, but which retroactively appears as their conditioning ground and which they subsequently recompose themselves on the basis of. "This is the body that Marx is referring to when he says that it is not the product of labor, but rather appears as its natural or divine presupposition … Everything seems objectively to be produced by capital as quasi cause."[58] It is a great stasis coupled to and produced as a secondary effect of the connective syntheses of the forces of production; because it is only apparently, retroactively, or quasi-productive in its own right, they also call it "antiproduction," a surface of recording that is adjacent to the productive process.

> Production is not recorded in the same way it is produced … [W]hen the productive *connections* pass from machines to the body without organs (as from labor to capital), it would seem that they then come under another law that expresses a *distribution* in relation to the nonproductive element as a 'natural or divine presupposition' (the disjunctions of capital). Machines attach themselves to the body without organs as so many points of disjunction, between which an entire network of new syntheses is now woven, marking the surface off into co-ordinates, like a grid.[59]

Finally, this antiproductive stasis also functions as a "socius," or a kind of virtual body of the social:

> It … constitut[es] a surface over which the forces and agents of production are distributed, thereby appropriating for itself all surplus production and arrogating to itself both the whole and the parts of the process … [T]he socius as a full body forms a surface where all production is recorded, whereupon the entire process appears to emanate from this recording surface.[60]

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[58] *AO*, 10.

[59] *AO*, 12.

[60] *AO*, 10.

This socius or virtual social body records and assigns places to the productive movements that initially give rise to it, but which subsequently appear to be "miraculously" caused by it. As a principle of holding flows and capacities together, the socius has a divine or deity-like function because 1) it appears to be the cause of every effect, and 2) it is responsible for and absorbs the distribution of surpluses or excesses of all kinds (variously figured as exchange value, violence, and waste), apportioning these to locations on the social body. They describe three different types of socius (the body of the earth, the body of the tyrant or despot, and the body of capital) corresponding to the three social formations discussed above (territorial, despotic, and capitalist). The capitalist socius, for example, distributes surplus exchange value by class, violence by race, geography, gender, etc., and waste seemingly into thin air (i.e., it does not account for these flows, and disavows them while they nevertheless accumulate to threaten the earth's reproductive capacity). The tyrant or despot sets itself up as absolute authority over other all flows, demanding tax or tribute and monopolizing the use of force. And the earth-socius distributes surplus through economies of gift and theft, as well as in rituals of feast, potlatch, and sacrifice (i.e., waste in the Bataillean sense of expenditure), holding back the emergence of auto-generative exchange value (capital). History is in part the sedimentation of these principles and productions of distribution, and in this respect infrastructures are perhaps especially durable strata.

Deleuze and Guattari also describe the passage from connection to disjunction in terms of a transformation of "energies": from what they call the energy of "libido" (raw drive for encounter) to that of "Numen" (the appearance of a God-like force that gathers all elements and renders them as detachments or divisions from its great static mass).

Beyond this is an energy of conjunction that they call "Voluptas," which gives rise to a subject of enjoyment as a residuum of the process and identifies enjoyment with a particular source ("so it's X"). But the desire for electricity itself does not quite reach this third stage. It is desired only as passage between physical energies, transforming from a source used in generation, to electricity, to myriad forms of light, heat, motion, sound, etc., such that electricity simply enables obtaining the thing actually identified with enjoyment. Electricity thus functions as a numinous, undifferentiated mediator of these series of transformations, a middle stage binding arrays of energy sources and forms of consumption. But it plays this role only due to a particular regime of infrastructural mediation embodied in the grid, which has the function of transforming these series of flows into a massive and uninterrupted stasis – i.e., into a profile resembling the stock. Electricity forms a smooth surface that serves as the apparent precondition immanent to an entire mode of life, traversing the home, the office, the factory, and much more. From its body sprout miraculous machines of all kinds, sustained by an invisible, humming power. Truly, then, a parody of a Sun-god long ago forgotten: an original stock from which all flows are merely a partial share or subdivision.

Dominic Boyer points to a similar kind of binding effect in describing infrastructure as a "potential energy-storage system, as a means for gathering and holding productive powers in technological suspension."[61] But the use of the physical concept of potential energy here is misleading if taken too literally. For Marx, as in the main thrust of Boyer's account, what is decisive is the contradiction between, on the one hand, the capacity of infrastructure as fixed capital to contribute to the production of use values with decreasing human input, and, on the other hand, the capitalist system of using

[61] Boyer, "Infrastructure, Potential Energy, Revolution," 228.

human labor time as the "measuring rod" (Marx) or instrument of "recording" (Deleuze and Guattari) of social production as exchange value. The key for Marx, however, is the radical disjunction between these terms: it is not that energy (and Marx does at least sometimes mean actual muscular energy, on one side of the disjunction) is literally transformed into a substance called value (which is then entirely mysterious, a metaphysical entity), but that it is registered in a different manner of being, as inscription or information. For Marx, value under capitalism is an accounting system for social labor time, nothing more. It is not the accumulation of a substance, but rather the tension between riven incommensurables – as well as the non-reified relation of holding that binds them – that is the real δύναμις or dynamite poised to "blow the foundation sky-high." Perhaps better to speak of Numen, if only insofar as it helps mark this difference.[62]

Although today, and certainly within California, electrical infrastructures tend to be firmly ensconced within a capitalist socius, electricity adds another surface or layer that exhibits remarkably disjunctive effects of its own. It works to detach and insulate life from the rhythms of the earth, adding a temporal dimension to what Nicole Starosielski

[62] In a counterintuitive, Bergsonian fashion, exaggerating this difference may actually deflate a lot of metaphysical confusion about the nature of value that is always ready to spring up in discussions of ecological crisis especially. Part of the minor slippage in Boyer's account here may come from a point of vagueness in the Burkett and Foster article he quotes, especially if taken out of context: "Of course, this value (energy) surplus is not really created out of nothing. Rather, it represents capitalism's appropriation of portions of the potential work embodied in labor power recouped from metabolic regeneration largely during non-worktime." Paul Burkett and John Bellamy Foster, "Metabolism, Energy, and Entropy in Marx's Critique of Political Economy: Beyond the Podolinsky Myth," *Theory and Society* 35, no. 1 (2006): 127. What is unfortunate in this quote is its possible suggestion of an equivalence between value and energy; rather, these should be taken to designate separate, incommensurable series. It is true that capitalists get more energy (labor) than they pay for; however, as *value* it is only a representation of that work, which is apportioned according to a distribution of social power assigned on a preexisting class basis. These authors are exceptionally clear on this point and its importance elsewhere. See, e.g.: John Bellamy Foster, "Marx, Value, and Nature," *Monthly Review*, July 1, 2018; John Bellamy Foster and Paul Burkett, "Classical Marxism and the Second Law of Thermodynamics: Marx/Engels, the Heat Death of the Universe Hypothesis, and the Origins of Ecological Economics," *Organization & Environment* 21, no. 1 (2008): 3–37.

calls "strategies of insulation": "modes of spatial organization that are established to transform potentially turbulent ecologies into friction-free surfaces and turn precarious links into resilient ones."[63] While we may be passive to this operation, the operation itself is furiously active to the point of obsession, stamping out traces of intermittency and interruption wherever they might appear. We can now properly diagnose the disavowal of intermittency that goes on in places like California as a case of paranoia, in the specific sense that Deleuze and Guattari give it: when a body begins to experience any appearance of its constitutive organs as an intrusive threat, as so many alien machines persecuting its very existence.[64] They are repulsive to it; it wants to go on living in a castle in the air and continuously screams, despite all evidence, that it has really built one for itself.

Without conflating the two, this describes not only a phenomenological alienation, but also a material rift. Electricity inserts itself into and furthers a metabolic rift, holding the social energy metabolism at a particular degree of intensity, and locked into a particular rhythmic pattern of production and consumption that is deeply configured by the demands of capital. Such energetic intensity is likewise sustained by a certain pattern and intensity of desire, maintaining itself in perpetual, if barely perceptible, arousal. In other words, it is a *plateau*, to use the term that Deleuze and Guattari borrow from Gregory Bateson: "a continuous, self-vibrating region of intensities whose development avoids any orientation toward a culmination point or external end."[65] It is a serious question for energy transitions whether the path-dependent intensities and rhythms of these distributive bonds can be overcome, even if energy sources are abundant. The remainder

[63] Nicole Starosielski, *The Undersea Network* (Duke University Press, 2015), 17.
[64] Cf. *AO*, 9.
[65] Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (University of Minnesota Press, 1987), 22.

of this chapter provides a brief overview of the historical syntheses that have led California to its current situation, and the consequences that these complexes spell out for the recent introduction of massive amounts of solar energy into their mix.

Distributing excess, stupidity, and lack

On an individual level, we form a connective synthesis with electricity whenever we use and become adapted to it; in many cases, it is something one is passively born into. Historically and systemically speaking, however, a much more active production is required. Transmission lines must be laid, sources of generation established, authority over different levels and components of the network fought over, carved up, or integrated, and electricity gradually entangled to greater and greater degrees in people's lives. The growth of these infrastructural systems is typically marked by tendencies that are tantalizing and confounding in their ambivalence. On one hand, there is a profoundly socializing tendency, as the highly scale-dependent economics of electricity pushes toward greater geographic integration and management by a single authority, a role which states or municipalities are generally quick to fill or at least heavily regulate. Bound up with this tendency are the discourses of liberation from labor and lack that have long accompanied electrification. On the other hand, true to Marxian theory, it is in many cases capital's own laws of development that lead just up to this precipice where production can be planned, rational, efficient, and emancipatory, and yet the same conjuncture of capital and the state works to forever hold the network back from this threshold of real transition. Such a tendency must constantly reintroduce lack where it is otherwise completely feasible to supersede it. It is, in other words, a constantly shifting battle between two tendencies of distribution: one rationalizing, and the other profoundly

irrational, even "stupid." Deleuze and Guattari locate this tension squarely in the relation between antiproduction and modes of distribution that create lack from excess:

> On the one hand, [antiproduction] alone is capable of realizing capitalism's supreme goal, which is to produce lack in the large aggregates, to introduce lack where there is always too much, by effecting the absorption of overabundant resources. On the other hand, it alone doubles the capital and the flow of knowledge with an equivalent flow of *stupidity* that also effects an absorption and a realization, and that ensures the integration of groups and individuals into the system. Not only lack amid overabundance, but stupidity in the midst of knowledge and science …[66]

Capital in general has a contradictory relationship with excess, in that it constantly tends toward overproduction (of both use and exchange value), but then faces a crisis of "realization" as products can no longer be sold following the saturation of markets and reduced purchasing power of the masses owing to extreme concentration of wealth. Electricity has its own idiosyncratic expressions of this relationship. As discussed above, excessive production of generation capacity is a key component of the war against intermittency, but then becomes a new potential source of blackouts if this excess is not managed properly. But under a capitalist axiomatic, "proper management" means finding a market before it means meeting existing need or desire. This entails the production of consumption, the production of new needs and desires, which the American electrical industry actively worked toward in its early days, in particular ways that exploited the spatial, temporal, and social dynamics of the emerging grid.

To understand these dynamics, we can mark out several elements that tend to drive the expansion of electrical networks and hence the production of excess. The first element has to do with the scale-dependent economics of the grid. Electricity is a classic

[66] *AO*, 235–6.

case of what since John Stuart Mill has been called "natural monopoly."[67] That is, the amount of capital required to compete with an existing electricity provider is so much higher than the marginal cost of that provider extending their services to reach new customers that a significant barrier to market entry is formed. This is especially true with respect to transmission and distribution infrastructure (T&D, in industry parlance), where the cost of extending an existing line to, e.g., a new house on a street that is otherwise already served is generally trivial compared to what it would cost a rival to run a line out to a new, unserved street. But the same is true internally for a single company: once the basic infrastructure is in place, the profit gained by extending service comes at a decreasing marginal cost. This is a major reason why electricity benefits from economies of scale, as well as a major reason why, historically, electric utilities are often owned or taken over by governments. In the US, and in wealthier countries in general, exceptions to this rule are much more frequent; in California, the vast majority of the state is served by three large, private investor-owned utilities (IOUs): Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). A notable exception is the city of Los Angeles, which is served by the Los Angeles Department of Water and Power (LADWP), the largest publicly owned utility in the US.

If the natural monopoly effect has to do with spatial extensity, the second element has to do with temporal intensity. This is the concept of "load factor", which, as Thomas Hughes describes, has been a substantial driver of the evolution of electrical systems from their beginning.[68] Load factor is defined as the ratio of the average utilization of generation capacity during some time period to the peak amount during that period. As

[67] John Stuart Mill, *Principles of Political Economy* (Prometheus Books, 2004). See especially Book II, Ch. XV, and Book V, Ch. XI.

[68] Hughes, *Networks of Power*, 218–220.

early as Edison, electrical engineers and power companies realized that maximizing return on investment would depend not only on extending the size and reach of their generation capacity, but also on setting this capacity to work to its fullest extent, as regularly and constantly as possible. The basic insight is that electrical infrastructure must be built to handle peak loads (as capacity cannot be increased on the fly, and overloads can fry and thus interrupt the system), so producers are incentivized to minimize the time that this capacity sits idle. The just-in-time temporality of electricity production is crucial here: because storage has always been and is still extremely difficult, power must be consumed immediately, and therefore generation must be triggered by or, preferably, anticipate demand. The true concept of load factor (as distinguished from what is technically called demand factor) is thus that a producer must be capable of meeting the peak demand of each consumer when they need it; it is an individual relationship between a buyer and a seller, which is why many utilities charge variable rates based on individual load factors.

The need to do this for all customers in the aggregate creates additional constraints and opportunities for producers. In order to optimize load factor across the system as a whole, utilities are incentivized to incorporate users with diverse energy needs into their service base, so that the timing of peak demand from some will synchronize with a period of low demand from others, and the total load is kept as close to a constant maximum as possible. The simplest way to do this is to "exploit the diversity of human geography" by extending grid systems over "a large geographical area where the population engage[s] in a wide variety of energy-consuming activities," including both industrial and residential areas.[69] For example, industrial energy usage is

[69] Hughes, *Networks of Power*, 463.

typically highest during the middle of the workday, while residential demand typically peaks in the early evening, with a smaller peak in the morning, as people get ready for and return from work, school, and other engagements. Corresponding to this diversity principle for improving load factor is a third element called economic mix, which Hughes describes as the exploitation of natural (as opposed to human) geography, meaning diversification of the energy sources used for generation. California's continued investment in fossil fuels can be seen in part as a hesitation to give up on this long-standing principle. Well before the intermittencies introduced by solar and wind generation, electrical system planners realized that each source – coal, hydroelectric, etc. – has its own characteristic capacities, temporalities, and threats of interruption (from coal market shortages, to drought, to labor strikes), and therefore that combining a diversity of sources helps to produce a more constant, reliable supply. According to Hughes, by the 1920s American utility companies began to extend the logic of energy diversity to "a higher level of abstraction," into what was called "financial diversity" (essentially the diversification of investment portfolios among owners of capital in the energy sector).[70] In short, the principle of economic mix, entailing diversification of energy sources and capital investments, shows how from very early on the electricity industry adopted the statistical logic of insurance, whereby individual risks are pooled so

[70] As explained by the head of General Electric at the time: "If one owns a light and power plant in a single community, his investment and his earning power is subject to the risk of that community. Floods may come and wipe it out; cyclones may hurl it down; crops may fail; business depressions here may be acute. The capital invested in that plant, if owned by a single man, is subject to those contingencies. But if men combined their investments in a large number of plants, widely diversified geographically, the floods will never come to all at once; the failure of crops will never come to all at once; a depression in business is unlikely to come to all at once, if the diversity is widely made. Therefore, a given investment in a group of plants is much safer than an investment in a single plant of similar amount. Not only is the principal safer but the continuity of return is better insured." Ibid., 399.

that the aggregate outcome is predictable and returns on investment are thus rendered consistent.

The exploitation of energetic, geographical, social, and cultural diversity by electric companies follows, on the one hand, a basic principle of ecology: a system containing a rich diversity of counterbalancing needs is much more stable and resilient than a monoculture. But biological ecosystems are built up slowly, and where such rich diversity exists it is rare that a single species, much less an individual or small group within a species, has overwhelming responsibility for the development of that system – and to an even lesser degree intentionally so. The rapid and oligarchic development of electrical systems, by contrast, meant that from the beginning, any useful counterbalancing of needs had to be accomplished by apparatuses of explicit planning and prediction. "Diversity … was fully exploitable only if predictable."[71] As early as the 1920s, the electrical industry began to employ increasing numbers of engineers to develop forecasting and control systems for the emerging grid, including analog computer systems. These efforts required the collection and organization of massive historical records of statistics spanning "load curves, and information about changes in population, transportation, industrialization, and social patterns, and the weather. Utilities with hydroelectric plants in the mix also used historical hydrographic data and kept a running record of rainfall, snowfall, run off, and other relevant details."[72]

Considerations of load factor and economic mix have historically driven the evolution of grids to a large extent, and together they compound the tendency toward geographic expansion and the natural monopoly effect. But if the latter effect has often

[71] Ibid., 369–70.
[72] Ibid., 367–8.

served as justification for centralized government control of electric utilities, load factor and economic mix are resolutely capitalist principles, and tend to be dominant forces where electricity is most thoroughly submitted to the axiom of valorization (return on investment). As Hughes puts it:

> If a would-be Darwin of the technological world is looking for laws analogous to the environmental forces that operate in the world of natural selection, the economic principles of load factor and economic mix are likely candidates. In the history of supply systems, these embodied the values of a culture that was capitalistic, a culture where interest on capital was calculated to ascertain the cost of goods and services. Because electric power systems were capital intensive, interest was of paramount importance. The cost of capital was calculated by the utilities operating electric power systems irrespective of the form of ownership—private, public, or mixed private and public. In a culture that did not calculate capital cost – the medieval Western civilization for instance – electric light and power systems would have grown differently.[73]

Load factor and economic mix both contribute to the spatial, informational, and authoritative integration of large regions under the same network. But under a capitalist law of development, this system growth driven by the quest for profit often metastasizes far beyond the "rational" use of natural resources. In fact, the entire history of electricity in California can almost be summed up as a demonstration of this principle. At the dawn of Californian electrification in the 1890s, the settler population of the region was still undergoing explosive growth in the aftermath of the gold rush four decades prior. But resources to sustain the way of life envisioned by many of these newcomers were in short supply, including energy sources for electricity generation. Building a settler utopia in this largely desert region required producing an artificially abundant availability of the

[73] Ibid., 462–3. It should be noted that Hughes' account deals primarily with the history of grids in the US, Britain, and Germany from the late 19th to early 20th century, all contexts in which capital was the dominant, though by no means the only, regime at play. An interesting aspect of Hughes' assessment in this quote is that this axiomatic is a matter of economic form over and above the question of political power or ownership. To demonstrate what he means here, consider a utility like Hydro-Québec, which is publicly owned, but operated according to the form of a private corporation, with its own assets and investments that it is mandated to maximize returns on within certain constraints.

productive forces of nature by brute force, clearing the land of indigenous populations and transporting resources long distances into settled areas.[74] Initially, the electric industry relied on coal imports from Australia, which made power almost prohibitively expensive. However, engineers quickly began to exploit the near-instantaneous transmission of electricity itself as a way of conquering these distances. In fact, long-distance transmission of electricity was a practice largely pioneered in California. It "made the remote lakes, streams, and rivers of the Sierra Nevada power sources first for relatively nearby mining towns, then for neighboring farm communities of the great central valley of California, and finally for the far more heavily settled coastal cities."[75] Once this technology was available, it was implemented with unbridled enthusiasm:

> Among these Californians there was 'no respect for constituted authority … [on] hydraulic, mechanical and electrical matters. If an impossible dam has to be erected … they build it … if an altogether unheard-of bit of tunnel has to be made to connect with a quite impracticable flume … they bore the tunnel and build the flume … if three or four stations must be operated together in defiance of all precedents, in go the switches and the plants operate.'[76]

Long before Silicon Valley championed technological fixes and private investment over any kind of centralized or collective planning, the early development of electrical infrastructure in California was characterized by very similar forms and preferences.[77]

On the whole, California's situation is reminiscent of the one a number of countries found themselves in during the immediate aftermath of World War I: **"**The extremely large electric generating stations that were built to fill the pressing and unusual needs for electric power during World War 1 survived the war and became, in a sense, a

[74] An additional contemporary example is water infrastructure, which has been plagued by drought exacerbated by climate change in recent years, with resulting dry conditions leading to devastating wildfires in the region.

[75] Ibid., 264–6.

[76] Ibid., 268.

[77] Cf. Richard Barbrook and Andy Cameron, "The Californian Ideology," *Mute* 1, no. 3 (1995).

solution in search of a problem."[78] Rather than warring with other states, California is at war with intermittency and with its own geography. Its electrical infrastructure has an almost "wartime style," as Hughes might say. Deleuze and Guattari also highlight the role of warfare in absorbing capitalist overproduction – following Bataille, for whom the stockpiling of undispersable energy is one of the chief dangers of capitalist general economy, leading inexorably to orgiastic expenditure in ever more destructive warfare.[79] In California, the "war" is much more protracted, subterranean, and quotidian, channeled through the interstices of the everyday. Historically, the problem found for the solution was to stimulate demand in the right sort of ways (production of consumption). Early electrical companies did not just exploit existing diversity of consumption patterns to balance their load factor and economic mix, but also took active measures to produce new demand during downtime. Key to this was the electrification of domestic space, including mass advertising campaigns pushing the adoption of home appliances that promised to modernize and lighten the burden of work done largely by women at times that would complement energy consumption in business and industrial spheres. In 1920, General Electric announced a new goal: "the creation and fostering throughout America of a positive electrical consciousness which would normally express itself in a certain fundamental 'want' – the desire of individual families to make their homes into electrified dwelling places.'" During this period, the major American electric companies, General Electric and Westinghouse, began to buy up smaller appliance manufacturers, and entered that business in part because it helped them improve their load profile.[80]

[78] Hughes, *Networks of Power*, 286.
[79] *AO*, 235; Bataille, *The Accursed Share*, 23–25.
[80] Nye, *Electrifying America*, 259ff. The quote is from p. 265.

Next to come was rural electrification, taking off in the New Deal era of the 1930s, which, although heavily backed by the federal government, was also made feasible in a way it had not been previously by the buildup of urban electrical systems, now hungry for new markets and sources of diversity to stabilize themselves with. The effects of such developments are contradictory and perhaps counterintuitive. On one hand, it would seem that programs such as the Rural Electrification Act (1936) should work to heal the rift between town and countryside, perhaps making up for the flows of resources taken from rural areas in agriculture and other industries by providing a subsidy of another type of energy that could ameliorate the impoverishment of rural life and culture under capitalism.[81] And indeed, these policies did contribute to a short-term rejuvenation. But the history of electricity is replete with examples of how the smoothing over of one kind of difference – specifically, spatial, temporal, and social differences in access to electrical energy – provides a surface for the reterritorialization and intensification of economic and social disparities produced by capital. Over time, electrified farms required less manual labor, and many agricultural communities dispersed and fled to the cities following these developments. At the same time, and in part to accommodate growing urban populations, electrification greatly facilitated the suburbanization of countryside immediately surrounding cities, soon to become havens for the wealthy and middle classes to maintain access to the city while remaining apart from its less desirable elements.[82]

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[81] Lenin appears to have thought along very similar lines; see V.I. Lenin, "Report on the Work of the All-Russia Central Executive Committee and the Council of People's Commissars Delivered at the First Session of the All-Russia Central Executive Committee, Seventh Convocation," in *Collected Works, Vol. 30*, trans. George Hanna (Moscow: Progress Publishers, 1965), 315–36.
[82] Nye, *Electrifying America*, 383–4. For another example of the way that the leveling effect of an expansive grid ultimately becomes the surface for the intensification of social divisions, see Ronen Shamir, *Current Flow: The Electrification of Palestine* (Stanford University Press, 2013).

In California today, the possibilities for geographic and social expansion largely exhausted among existing, long-electrified communities, excess appears to be increasingly absorbed in finance. The tendency toward amassed, centralized, and constantly utilized generation capacity is counteracted by a combination of two factors: first, fragmentation and inefficiency owing to the thousand tiny breaks, detachments, and territorializations effected by private ownership over various pieces of the infrastructure, including the sale of electricity to individual consumers and entities mediated by a market; second, the usage of increasingly complex and speculative financial arrangements to corral this self-dividing *agencement* of moving parts back into a pattern that tends toward the elimination of intermittency. Centralized planning has long been fiercely resisted by powerful private electric utilities in the US, and California's deregulation of the industry after 1998 is yet another episode in this tradition. Practically the only option left to the state government to ensure a consistent energy supply under such circumstances is thus brute-force redundancy, which creates its own problems and inefficiencies. Whereas in many regions states typically seize control of natural monopolies on electricity, in California it now works largely to lower the barrier to competitive market entry by subsidizing the construction of new generating plants, largely irrespective of demand. This is a reminder of the perversity of the state subordinated to capital, and to the "axiomatic" character that Deleuze and Guattari ascribe to the latter: such strategies do not even need to stimulate consumption by producing new pleasures or promising liberation from drudgery, but rather raise the level of extraction of profits from consumers directly (decoupling the maximum production of exchange value from the production of use value or enjoyment).

Similar could be said for payments made to neighboring states to shunt around excess power during peak production. What might initially appear to be a prudent effort to avoid "waste" is clearly only so according to a perverse expression of the principle that no materials move without realizing exchange value, even to the detriment of the producing region (these payments are made by the California Independent System Operator, a non-profit tasked with managing T&D on the grid; however, the bill is ultimately footed by consumers). Indeed, the very nature of a *utility* as an economic form is rich with potentially productive contradictions. On the one hand, states or other public authorities typically get involved out of recognition that the use value of a certain good is necessary for a given mode of social functioning, and therefore hold back the market from completely dominating its production. On the other hand, this limiting of the market is itself held back by it on a deeper level, expressed as an inversion of the usual capitalist law according to which every exchange value, despite being the real object of interest for capital, must nonetheless by borne by a use value, the specific use value of which is irrelevant.[83] In the utility-form under capitalism, it is rather that every use value, despite being singled out as a specific object of interest by the state, must nonetheless be borne by a transfer of exchange value, even if this works against the interest of the public in whose name the state has declared a commodity essential. No degree of grid "smartness" is enough to fully counteract this underlying stupidity. An alternative economic arrangement, such as one in which gifts of surplus energy are given freely, or social practices developed to take advantage of momentary surplus in potlatches of Bataillean expenditure, is simply unthinkable within a mode of production and distribution inscribed

[83] Marx, *Capital, Vol. 1*, 295.

on a capitalist socius and subordinated to its principles of movement and coordination of flows.

A logic of exchange, insofar as it is quantitatively precise, also requires clearly delineated entities, whether persons, corporations, or state borders. Again, the communistic potential of amassed generation capacity is held back by a principle of distribution that insists on segmenting and carving out territories from this great stock that might otherwise flow freely. It is constantly overlaid onto a social ontology defined by private property relations. At the same time, the sheer complexity and multiple interdependencies of the electrical grid give the lie to frontier visions of independence and self-sufficiency. These dynamics and superimposed tendencies are crucial to track in evaluating the potential of renewable energy transitions. Solar imaginaries sit perfectly poised between two countervailing visions of liberation: a monistic overcoding of all segmentary distributions of lack by a single source of infinite surplus, and a pluralist decentralization of energy relations that provides full autonomy to every node. Both of these visions, however, tend to underplay the problem of intermittency, the infrastructural dynamics of distribution, and the interrelation between these. The final section of this chapter explores these themes.

Solarity: Whence a communism of the flow?

The electric grid, the means of transmission and distribution of electrical energy, is designed to ward off intermittency and render uncertain flows into an orderable aggregate. Its tools for doing so include taking advantage of geographic and social diversity, brute-force redundancy, predictive modeling, and financialization. It is worth noting that these strategies are not new, and all developed to various degrees while

energy sources were predominantly of the non-flowing, "stock" type. Flow sources like solar exacerbate the need for such management strategies, and will no doubt inspire new and intensified iterations of them, but capitalism may not need to innovate much on the basic themes and principles of its arsenal to substantially recuperate solar flow toward its ends. In enabling energy management through property and market relations, the grid has already accomplished what earlier forms of appropriation of flow could not. Malm describes how, in 19th century Britain, flows in the form of water, light, and air were considered to be *res communes*, by nature "incongruous with the principles of private property."[84] On his view, the same seems likely to apply to solar; accordingly, one chief barrier to energy transition is that persistently declining costs of solar production (owing to improvements in the technology, but more fundamentally to the near-ubiquitous abundance of sunshine) lead to declining profit potential and thus hinder investment in the area. In other words, capital may agree with Malm's hopeful assessment that "realisation of the potential of solar and wind on the basis of capitalist property relations would, at some point, become another self-undermining, involuting enterprise," and thus stay away.[85] Historically, there are data that bear this out, as many large investors have proved skittish about the long-term profit potential of solar and backed away.[86] However, the fragmentation, segmentation, and exchange relations made possible through transmission and distribution, as evident in California, may give reason to think that this may not long be the case, where political structures allow capitalist control of the

[84] Malm, *Fossil Capital*, 118.

[85] Ibid., 439.

[86] E.g., Shell pulled out of its renewable energy investments in 2009; Google defunded many of its renewable energy projects in 2011 (including a major investment in California's Ivanpah CSP plant).

infrastructure to run unchecked. Therefore, I am more skeptical than Malm when he claims the following:

> One thing seems certain, though. The spatiotemporal profile of the flow does not allow for anything as lucrative as the primitive accumulation of fossil capital: since the fuel is not hidden away in a separate chamber, but rather hangs like a fruit for anyone to pick, there is little surplus-value to extract in its production – no gap between the location of the energy source and that of the consumers in which the chasm between capital and labour could be reproduced. To some, res communes remain off-putting.[87]

For the grid is certainly a direct embodiment of such a gap, and the need for someone to operate and maintain this infrastructure makes it a site of political contestation. Further chasms abound as long as electricity remains a disavowed site of distancing rhythms of consumption from the intermittent rhythms of the flow. The grid structure exists to balance shortage and excess and ensure reliable constancy of flowing power; in accomplishing this it produces a surface of smooth, abstract space-time that enables the intensification of capitalist dynamics on other levels, which in turn become increasingly dependent on such a pattern of energy supply. This problem exceeds the question of property relations in the immediate sphere of energy, and even centralized, planned, rationalized, and decarbonized grids will have to contend with it. This explains why communities targeted for renewable energy development are sometimes less than enthusiastic, even among those committed to reforging sustainable relations with the earth. As one anti-wind activist from the Isthmus of Tehuantepec in Mexico put it to Howe and Boyer: "All this supposed clean energy is going to power more Walmarts and cement factories, and those are the true problem."[88] At some point, whatever their source,

[87] Malm, *Fossil Capital*, 440.

[88] Cymene Howe and Dominic Boyer, "Aeolian Politics," *Distinktion: Scandinavian Journal of Social Theory* 16, no. 1 (2015): 31–48.

it becomes necessary to ask what flows of electric current enable, sustain, and hold in place.

In this context, what to think of that other great promise of solar, its alleged tendency toward decentralization and localization? The capacity for decentralized or "distributed" generation, with every homeowner and business owning their own means of electricity production, has long been seen as a significant advantage of solar power – dating back, in the American context at least, to an early but short-lived boom in interest in solar during the oil crisis of the 1970s, when many consumers became acutely conscious of their dependence on foreign energy sources.[89] The fantasy of independence in a capitalist market system (which by definition relies on the division of labor and fragmentation of self-sufficiency) appears to be a persistent part of the appeal of non-utility-scale (e.g., rooftop) solar. In California today, although they represent only a small but growing percentage of current generation capacity, rooftop solar panels are a significant source of public and private investment, both financially and ideologically. Between 2007 and 2016, the California Public Utilities Commission (CPUC), the state body that regulates privately owned utilities, offered $2.167 billion in rebates to incentivize residential and commercial rooftop panel installation on existing buildings, for customers of the three major investor-owned utilities. This was one component of a wider $3.4 billion initiative called Go Solar California, which also included $400 million for solar in new homes and $784 million for customers of publicly owned utilities.[90] In 2018, the California Energy Commission (CEC) voted to require that by 2020, nearly all

[89] Joel West, "Too Little, Too Early: California's Transient Advantage in the Photovoltaic Solar Industry," *Journal of Technology Transfer* 39, no. 3 (2014): 487–501.

[90] "About Go Solar California." n.d. Accessed March 5, 2019, https://www.gosolarcalifornia.ca.gov/about/index.php.

new home construction and major renovations must have solar panels, or, where panel installation is not suitable, must either have access to a community solar project or receive compensating efficiency upgrades. Commercial construction will be required to follow suit by 2030.[91] Even disregarding new construction and possible technological developments, one 2016 report estimates that California has the technical potential to meet 74% of 2013 electricity demand from rooftop PV alone – that is, independent from large utility-scale "solar farms."[92]

But the nature of decentralization is ambiguous and potentially misleading: it does not usually mean that individuals, buildings, or even communities become energy self-sufficient, as staying connected to the wider grid is essential to fill in during times of local shortage if the effects of intermittency are to be warded off. Most directly, the implied sense of decentralization is generally economic, in that many ordinary people can suddenly become energy producers, selling power they do not need to the grid. Here once again it is useful to view the system as a complex of different logics, rhythms, and tendencies: if the sun provides a fluctuating abundance, the grid produces a tendency toward stockpiling and measured, smoothing distribution, and decentralized production provides a system of cuts into this flow, parceling it out into discrete territories which can communicate with each other only via mediation through a market. And as Timothy Mitchell describes, deconcentration does not necessarily lead to more democratic outcomes: the switch from coal to oil, for example, supplanted critical points of

[91] David Roberts, "California Will Require Solar Panels on All New Homes. That's Not Necessarily a Good Thing," *Vox*, May 15, 2018.

[92] Pieter Gagnon et al., "Rooftop Solar Photovoltaic Technical Potential in the United States. A Detailed Assessment," January 1, 2016, 34–35. This is significantly higher than the estimated potential for other US states, which is typically closer to 35-40%, with only Maine and Vermont also exceeding 60% (p. 25). Note that this report provides upper bounds on technical capacity, not predictions of what is likely to be actually implemented.

intervention for coal workers with a more diffuse and elusive target, as "oil flowed along networks that often had the properties of a grid, like an electricity network, where there is more than one possible path and the flow of energy can switch to avoid blockages or overcome breakdowns."[93] Even deconcentrating economic control over productive nodes in the network, while certainly facilitating a significant difference in profit dynamics between solar and oil, may not lead to truly transformative outcomes if the means of distribution are not democratized and transformed along with those of generation.

Could solar then enable the grid to be done away with entirely, giving way to completely localized, self-contained bubbles of production and consumption? This is the vision of Hermann Scheer, the storied architect of Germany's *Energiewende*. For Scheer, the chief environmental advantage of solar is not even at the level of emissions in electricity generation, but in virtually eliminating the long supply chains required to transport fossil fuels and electricity alike.[94] Thus, he favors energy consumption in the immediate vicinity of production, tapping directly into the solar flow. Accordingly, he severely underplays the problem of intermittency and the social investment in avoiding it at all costs (a tendency which Malm criticizes him for as well[95]). To the extent that he does discuss it, Scheer's preferred solution to this problem is a version of the principle of economic mix, such that a diversity of energy sources ensures that power is still available when one source is not. But already this means management at the community or municipal scale at least, as no other source yet appears to approach solar's potential for distributed generation, and this means retaining the service of some form of grid. At

[93] Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2011), 38.

[94] Hermann Scheer, *The Solar Economy: Renewable Energy for a Sustainable Global Future*, trans. Andrew Ketley (Sterling, VA: Earthscan, 2002).

[95] Malm, *Fossil Capital*, 375.

scales small enough to satisfy Scheer, it is not clear that the intermittency problem can be solved simply by moving from an individual to a neighborhood or an entire city; following Hughes, the quest to exploit the diversity of economic mix has historically been an impetus for the grid to expand.

Another possibility would be improved storage systems for electricity, which would change the intermittency game dramatically. Although storage remains difficult to implement at sufficient scale, this is unsurprisingly a major area of current technical research. Without closing off possibilities for the eventual forms that this could take, it nevertheless seems possible to note certain likely dynamics if current trends continue. One major advantage of certain kinds of utility-scale CSP systems is that they enable storage of energy in the form of heat contained in molten salts. Of course, such systems require a larger grid structure, not to mention the development of wide swaths of open land (potentially destabilizing ecosystems such as the Mojave Desert in California[96]). Storage systems for smaller, e.g., rooftop-scale solar are less forthcoming, in part due to the high cost of materials for batteries large enough to be effective in this regard. Moreover, such materials must be extracted from somewhere (e.g., lithium, which is primarily mined in South America), thus adding length back to the supply chain that Scheer hopes solar will shorten. (Of course, PV panels themselves already have longer supply chains than Scheer's portrayal might suggest, requiring the mining and refinement of quartz into silicon – a process that produces huge amounts of toxic waste in Asia and especially in China.[97]) Most fundamentally, perhaps, small independent producers are unlikely to forgo all opportunity to realize a profit on unneeded surplus; thus, remaining

[96] Cf. Brennan, "Practices of Sunlight."

[97] Dustin Mulvaney, "Solar Energy Isn't Always As Green As You Think," *IEEE Spectrum*, November 14, 2014.

connected to the grid as a means of disposing of this surplus is likely to remain attractive to many. And here the same information, coordination, and prediction problems reassert themselves, as the stability of the system depends on the ability to monitor the distribution of excesses and deficits in advance of the real-time signals of market price. Silicon Valley has already begun to take notice of this developing niche. For example, the California-based startup Stem is developing AI tools to aggregate and manage networks of batteries containing unused surplus power (a design known as a "virtual power plant"), and has already begun to bid this excess into California's real-time energy markets (for more on the structure of these markets, see Part II).[98] It is not hard to foresee a situation in which the decentralization of energy production and storage facilitates the concentration of power among even smaller, more efficient types of players than traditional grid operators, with less regulatory oversight.

These considerations suggest further confirmation of a point that has emerged repeatedly in this chapter: that, as Malm suggests, "There might be methods to engineer a more abstract profile of the flow."[99] Malm sees this possibility chiefly through CSP and large-scale grids and energy producers; the problem, he argues, is that such schemes require "advanced planning and coordination" that capital has historically resisted with all its might.

> [T]here appears to be a general catch-22 freezing the transition [to sources like solar] … On the one hand, a return to the concrete fold of the flow would tear apart abstract spatiotemporality. On the other hand, an attempt to create the most abstract possible space and time out of the concrete flow would demand comprehensive planning. … Should we manage to get out in either direction, relations would seem to *have* to move in a more communal direction – in line

[98] Robert Walton, "Stem, PG&E Bid Aggregated Energy Storage into CAISO Real-Time Market," *Utility Dive*, September 8, 2015.

[99] Malm, *Fossil Capital*, 376.

with the concrete profile or the communist tendency of the flow.[100]

But the communisms at the end of each of these directions are not the same. Top-down central management, especially of a resource that most people would currently prefer to ignore, does not without further qualification make for anything one would be tempted to describe as "communal." Moreover, the particular role that electricity plays in wider economic relations means that it would be unwise to consider only the property relations involved in this immediate sphere, without considering the ways in which it may create infrastructural surfaces for the intensification of capitalist relations on other levels (even as the urgency of transition demands focused attention on the energy sphere). Relatedly, on the other hand, is it not clear that tearing apart abstract spatiotemporality would also precisely require planning, albeit perhaps of a different sort? This would involve not only the planning of electrical systems, but the planning of individual and social uses of time, folding them into the peaks and valleys of the flow. Does this require even stricter top-down control? Or, might there be forms of planning the flow that would be worthy of the name "communism"? We should not underestimate the difficulty of tearing apart the abstract surface on which so much of our lives are composed, or the multiple levels on which such a dynamic asserts and reasserts itself. Nevertheless, beginning to loosen its hold may prove an explosive historical force – much as the breaking of chemical bonds once did in the combustion of fuel.

[100] Ibid., 379.

Part II
Governance Machines;
or, Planning and Its Discontents

As Part I indicates, many of the tensions, contradictions, and possibilities for the future direction of electric infrastructures turn in some way on the concept of planning, and capitalism's resistance to it. In particular, I have emphasized how the information and coordination problems exacerbated by intermittent energy like solar make the need for something like planning even more pressing. The present chapter has two objectives, both of which are more speculative than those of the last. First, I will push a bit further on the reasons behind capital's aversion to planning, to show how this intersects with and emerges from the foregoing analysis of disjunction and rift. Second, I will outline three broad classes of response to these circumstances; i.e., three concepts or regimes of planning. These are not intended to be exhaustive of all possibilities, nor to be understood as mutually exclusive. The distinction between them is primarily analytic, and it is likely that any concrete solution or plan for a given scenario will have to compose with more than one of them (beyond giving different answers, they do not always answer the same question). As in Part I, my analysis remains closely informed by the dynamics and prospects of solar electricity (emphasizing themes of excess, uncertainty, and flow). I will continue to draw on the recent history of California, taking the example of the electricity crisis of 2000-2001. This was a particular failure of planning that both illuminates the general relationship of capital to planning and has set the precedent for many dynamics that continue in California today, including those described in the previous chapter. However, it will be obvious that at stake here is also a much broader question about the fundamental meaning of (something like) communism in our time –

what conditions it must respond to, with what horizons, and how it differs from past conceptions.

The first concept of planning is perhaps in reality only an ambiguous cousin, which today we know best as a tool increasingly favored by capital: prediction. I will attempt to sketch capital's investment in this form, but also how it can cut across capitalist tendencies to stage some of the immanent contradictions at its core. As the most straightforwardly technological response to the problem of planning, prediction is perhaps the most open to being repurposed as a tool for many kinds of political project, though this does not mean it is neutral; precisely this open-endedness, moreover, means that it has endless potential to be recuperated by existing forces as it is inserted into the vortex of capital. The second concept of planning, which is the one that perhaps comes most readily to mind in the case of large-scale infrastructures like electricity, will aim for a stronger intervention against prevailing dynamics. It is owed to the Leninist imaginary: centralized, top-down (or vanguardist), with a strong role for the state. Between these first two conceptions we will come up against a series of questions concerning the nature of the state, aggregation, and the division between energy and information. Finally, to develop the anarchist line that I have been tracking through Deleuze and Guattari, and to bring it up to date with present conditions and the contemporary articulation of capitalism's relation to contingency and uncertainty, I turn toward the concept of planning outlined in Harney and Moten's *The Undercommons*. Resolutely bottom-up, their concept orients toward self-sufficiency, a critique of needs, and the returning of questions of infrastructure to those of social practice in a way that completes the arc set out in the present project.

Anti-planning and the topography of accumulation

The pivotal question is why capitalism is so averse to planning. Previously, I have emphasized the way in which capitalism produces "stupid" or irrational distributions; i.e., it works against or beyond matching production with needs, subsuming needs to the demands of an adjacent logic (accumulation of surplus exchange value) that carries the social metabolism in its own direction. This disrupts the cyclicality of ecologically and economically sustainable production (in which, as much as possible, the proceeds and byproducts of production are returned as conditions of reproduction). Again, this is Marx's theory of the metabolic rift, which turns on the radical disjunction between use and exchange value, or the logics of production-for-consumption and production-for-accumulation. The resulting distributions, whether unaccounted-for accumulations of waste or rampant wealth inequality, are often understood as contingent accidents, unavoidable byproducts, or "externalities" of the capitalist economic system. There is a sense in which this is true, in that capital (precisely) does not have a master plan for society or for the earth; its logic is far too inhuman, its axioms far too simple and rigid, to describe in terms of intentionality. It works not toward a desired end-state but toward an eternal present, disjointed from time; it attempts to prolong its process indefinitely, not by extending its actual duration but by raising its intensity to a new power.

The question is thus how the reproduction of capital or any socius comes to depend on the reproduction or substitution of contingencies that first produced it. In this sense, the disruption of cycles that carries a system off in a deterritorializing line

accomplishes something important for capital. It produces fragmentation, the splintering of previously integrated ecosystems, human and otherwise. Fragmentation is a roll of the dice or a shuffling of cards. Sometimes it works against the continued ability to do work, in a quasi-entropic effect, as when the prevented return of waste to the soil depletes it (and this waste then accumulates as "noise" somewhere else). But it can also create differences that work against this entropy by serving as the engine and territory of capital's continued reproduction. Just when capital seems to have run out of new spaces of accumulation, its own dynamics of differentiation appear to have already stepped in, as if to recharge the voltage of a neutralized electromagnetic field. From the beginning, capital arose from a confluence and difference between freed flows: flows of people ripped out of integral relations with the land, and flows of money and means of production concentrated in another class and freed from any obligation but to valorize themselves.[101] This "setting free" of flows is what Deleuze and Guattari variously describe as the deterritorializing, decoding, or schizophrenizing drive of capitalism: it shakes elements loose from stable ecosystems of meaning and function, sets them out arbitrarily alongside each other, and transforms every incomparable quality into abstract and commensurable quantity. Taken to its limit, this confluence and intermingling of every flow would be absolute, nonproductive chaos and indeterminacy. In the sense that it unleashes this drive, "capitalism has haunted all forms of society, but it haunts them as their terrifying nightmare, it is the dread they feel of a flow that would elude their codes."[102] For this reason, every society (even actually existing capitalism) must work to

[101] Marx, *Capital, Vol. 1*, 874–5.

[102] *AO*, 140. See also p. 176: "How can this nightmare be imagined: the invasion of the socius by noncoded flows that move like lava? An irrepressible wave of shit, like the Fourbe myth; or the intense germinal influx, the this-side-of incest, as in the Yourougou myth, which introduces disorder into the world by acting as the representative of desire."

hold off this limit. This is just to say that even capital only loves the flows it can account for, and these are not flows in their *completely* decoded and uncertain state.[103] So there must be a second step, which is frequently missed in cursory readings of Deleuze. In order to be recuperated by a social system, the relation between flows must stabilize, must lock into a pattern (an "abstract machine"), so that the emergent socius or social machine appears as the ground or cause of everything that moves on its surface (the passage from connective to disjunctive synthesis, or from production to distribution). Private property, the division of labor (including that between city and country), and the class divide enacted in the wage relation are all ways of channeling, segmenting, and reterritorializing flows to hold them back from the limit. What is perhaps distinctive about capitalism, especially in its advanced and financialized form, is the way it operates close to this limit: decoding and setting new flows free, and then recapturing surplus as the difference or differential between two flows, at least one of which is variable and uncertain. Another word for this is speculation: a capitalist speculates on the difference between labor-power and its exchange value, knowing that it can obtain a relative increase in the latter (M-C-M'). Or someone speculates on the difference in value between fiat money and cryptocurrency, in hope that the latter will rise relative to the former. The production of these differentials enables new spaces of speculation and accumulation, ever more divorced from the increasingly already-enclosed and polluted earth that this house of cards nevertheless depends upon (and this is the point).

But, again, there is always a second component required for this to work. What holds the flows together in a distinct pattern, and measures them relative to one another?

[103] "What flows *on the socius* cannot appear as a flow except in correlation to a code: it is impossible to seize a flow other than by and through the operation that codes it." Smith, "Flow, Code and Stock," 44. Emphasis added.

Many things can play this role, but the general characteristic is aptly described by Deleuze and Guattari as recording or registration (*enregistrement*), which they situate again at the moment of distribution. This is because it takes place "in between" production and consumption, always subsequent to production but conditioning the ground for the next cycle: How are the means and proceeds of production accounted for and divided up? What "counts" in the production process, i.e., what of the laboring bodies is registered and inscribed by/on the socius? There is a bifurcation at work here too, in the spinning off of a representation from the process it represents. The state sometimes plays this role of overseer, standing apart as watcher and coordinator of flows, producing and acting upon flows of information about the others. Capital, of course, needs the state as one element holding it back from its own death drive toward absolute deterritorialization. But as much as possible, capital prefers to dislodge the flows of information as well, to set them to work within the process. The simplest manifestation of this is price: as Evgeny Morozov recently put it, "Market pricing has long been lauded for its ability to enable complex forms of social coordination with little or no central planning."[104] But decoded flows of information themselves have a tendency to fragment, differentiate, and form new terrain for speculation and accumulation. The whole process repeats.

For an illustration of these dynamics, consider the lead-up to California's electricity crisis in 2000-2001. Prior to the deregulation frenzy in the 1990s, the three major investor-owned utilities (IOUs) were each vertically integrated to handle all functions (generation, transmission, and distribution). On the rationale of increasing-returns-to-scale, they were operated as regulated monopolies, with electricity prices

[104] Evgeny Morozov, "Digital Socialism?" *New Left Review*, no. 116/117 (2019): 35.

"primarily based on cost of service and not the market." Vertical integration within a single company reduced transaction costs, allowed for planning of capital investments, and generally addressed a "need for coordination and for appropriate information flows."[105] Federal legislation enacted in 1978 (the Public Utility Regulatory Policies Act, or PURPA) had opened the door for market competition on the generation side, in the hope of increasing energy and cost efficiency, as well as stimulating innovation (including diversification and localization of energy production through distributed and renewable generation), in response to the ongoing foreign oil crisis. Throughout the '80s and early '90s, California had implemented PURPA in such a way that subsidized the entry of many new, smaller-scale, independent energy producers into the market by granting them long-term contracts at a fixed rate of return, so that they could recover operating costs. These inflexible arrangements, coupled with higher-than-expected construction costs of new nuclear facilities, had led to soaring electricity prices, and there was increasing concern over how the existing structure would meet the demand of California's growing economy. The failures of this kind of planning, coeval with the widespread ideology of deregulated market competition as a magical cost-lowering and innovation-stimulating panacea, began to make a less planned solution attractive to many interests. As it turned out, this was based on a "fundamental fallacy," as market competition could not compensate for the sunk costs from prior structures and decisions.[106]

What it did enable, however, was a vastly expanded terrain for new profits, in a field that had previously been saturated and closed. Even as generation was increasingly

[105] James L. Sweeney, *The California Electricity Crisis* (Hoover Institution Press, 2002).12–14.
[106] Ibid., 19.

opened to market competition, transmission and distribution were still strongly dominated by the economics of scale, and so would continue to exist under a monopoly structure. This "unbundling" of generation, and of electricity as a commodity differentiated from the infrastructure of distribution that it moved through, fragmented and exploded the complexity of the institutional structure of the grid. Though the IOUs continued to generate electricity themselves, they were required to treat this function completely separately from T&D, in order to prevent granting preferential grid access to their own electricity over the newer and smaller players:

> [A] utility could still include the three separate functions: generation, transmission, and local distribution. Ownership of the three functions, however, would not translate to decision making coordinated among these functions … a utility that both generated electricity … and sold electricity at retail would operate as if two separate companies owned these two functions."[107]

Actual decision-making power and operational control over the grid was delegated to a separate non-profit organization, the California Independent System Operator (CAISO), which went online in 1997. A further organizational structure, deliberately uncoordinated with CAISO, was created to manage a power exchange (PX) in which day-ahead and same-day auctions would be held to negotiate buying and selling of power on the grid, open to all suppliers. Longer-term contracts were prohibited, viewed as a plague of the older system (although later adjustments did allow for some purchase agreements to be made several days in advance). The auctions were structured so as to determine a single, hour-by-hour price to be paid by all buyers and received by all sellers; the schedule of these agreements would then be passed on to CAISO, which carefully monitored historical and real-time electricity usage and combined these with the scheduled loads to produce a forecast. CAISO was tasked with ensuring the stability and reliability of the

[107] Ibid., 33.

grid (i.e., preventing overloads and ensuring that all demand was met), and so would make load-balancing adjustments to its forecast in separate "real-time" markets to determine what would actually be transmitted through the grid, up to minutes before it was needed.[108]

Although these two markets were closely linked, the complex and fragmentary structure of the system created gaps and inefficiencies that could be exploited. James Sweeney, a sober and otherwise generally market-friendly commentator on the crisis period, puts the matter starkly:

> This organization structure – with management of the grid, dispatch of generators, and wholesale trading functions kept separate – was very different from the systems that had been adopted in other countries that had restructured their markets. Normally, these functions, which are integral parts of a smoothly functioning system, would be tightly integrated into one organization. This structure created the great risk that the functions would not be well coordinated with one another. / The resulting inefficiencies in these markets would provide opportunities for energy traders, such as Enron, to operate profitably; market inefficiencies could create profit opportunities through arbitrage and through selling financial instruments for managing the increased risks. Such profit opportunities to traders would stem directly from the costs the inefficiencies would otherwise impose on generators or consumers. It was a most remarkable public policy concept: California was creating market inefficiencies to make the system profitable for arbitrageurs (more-benign explanations for this separation are difficult to conceive.)[109]

Arbitrage is a method of exploiting the difference in value of an asset between two different markets – i.e., taking advantage of the fractured and inefficient flow of information about a commodity as registered through the mechanism of market price. The basic strategy in this case was to inflate price on the PX knowing that there would likely still be demand for CAISO to fill on the real-time market. This opportunity gave generators an incentive to withhold supply, thereby causing prices to rise, demand to go

[108] Ibid., 44–8.

[109] Ibid., 30.

unmet, and unplannable uncertainty in the system to increase.[110] The result was an approximately yearlong period of frequent and massive blackouts across the state, beginning in June 2000. Because the state had set a cap on retail electricity prices in an effort to keep consumer costs low through the policy transition, wholesale cost inflation by energy traders meant that intermediary T&D buyers (the IOUs) were unable to stay solvent. PG&E filed for bankruptcy in April 2001, and SCE very nearly followed, which plunged the industry and the society dependent upon it further into crisis.

California restructured its electricity industry with the hope of reducing costs and making the system more responsive to the flux of needs, challenges, and opportunities. To be sure, there were problems with its previous mechanisms for longer-term planning, which were extremely blunt instruments: since most of the system was privately owned, the state had few options but to subsidize overbuilding in order to maintain a reliable supply (a strategy that continues in California's approach to handling solar today; see Part I). But by gutting its ability to plan, proliferating institutional and informational gaps, and making itself completely contingent on highly volatile spot markets, California created a niche for whole new species of market players to emerge. Some of these players clearly exploited and manipulated these arrangements for short-lived profits, indifferent to the continued functioning of the system that supported and included them. A new dynamic had been established that depended on these uncertainties and inefficiencies for its reproduction.

[110] Ibid., 127–8.

Prediction, recording, and the rhetorics of stasis

As the case of CAISO suggests, under free market conditions, forecasting or prediction tends to be the favored technique of addressing the future when other forms of planning have been banished. Why is this? It appears to be a widespread pattern today, with artificial intelligence and machine learning (aliases for statistical prediction) having becoming the darlings of Silicon Valley and its imitators, even if in practice this often amounts to little more than rhetoric and hype. The energy sector has been no exception to this trend, and there is no dearth of AI applications for electrical grids in development or early implementation stages, including in California. However, as shown in Part I, the basic dynamics that make such a solution attractive (real-time production, massive coordination of diverse and variable elements), as well as the basic principles of the solution (record-keeping and statistical analysis) have played a large role in grid management from its inception. Grids may turn out to present an instructive prehistory of AI, with all of the contradictory tendencies of the grid we have seen in tow. For prediction does add something new compared to a completely unplanned system that lets the market run wild; as practiced, it generally incorporates the idea of matching production to needs, at large scale and complexity, and indeed this is precisely its attraction for a publicly regulated industry like electricity (again, the utility-form involves a reassertion of use value, as the name suggests). But the question is why prediction grows so readily under the light of the market, why it slips under the radar of capitalism's aversion to anything resembling planning.

On a temporal level, it could be said that prediction only pretends to be about the future, or that it has a profoundly impoverished sense of futurity. Fundamentally, it is

about concentrating the patterns contained in the past into the present, into a momentary decision to be made now, ultimately on the faith that the future will not be substantially different from that past. It presents an image of the future that is extrapolated from the past as if the modeled scenario were a system of mechanical parts simply continuing in their motion, with no new principle of operation introduced that cannot be derived from the existing dynamics of their interaction. This is why, in their book *The Politics of Energy Forecasting*, Baumgartner and Midttun argue that most forecasting has an "inherently conservative bias"; it fails to take into account real change, breakdowns in structures and institutions, and changes that might come about as a result of actors acting on the information provided by its own projections.[111] These authors importantly emphasize the institutional and rhetorical functions of prediction: what matters is not simply the technical "accuracy" of forecasts, but the decision-making structures that are in place around them concerning both inputs and outputs, as well as factors such as trust and perceived legitimacy of the technique. One can imagine all kinds of feedback loops: predictions can become self-fulfilling, self-undermining (as actions taken on their basis invalidate the trends they are based on), or can be simply ignored in terms of informing action (and so perhaps gain in legitimacy as the result of inaction). In any case, no matter how many hypothetical parameters are added and adjusted, or how many nonlinearities are accounted for, the logic of prediction tends toward a pathway-crystallizing if-then structure of reasoning, with qualitative uncertainty reduced to quantitative "confidence intervals." This impoverished and tamed futurity, which could also be described as a lack

[111] Thomas Baumgartner and Atle Midttun, eds., *The Politics of Energy Forecasting: A Comparative Study of Energy Forecasting in Western Europe and North America* (Oxford, UK: Clarendon Press, 1987), 6.

of historicity, perhaps gains prediction some currency with respect to capitalism's drive toward an abstract and unchanging present.

But at the same time, prediction approaches this present from an angle that is oblique to capitalism's drive, although not necessarily at cross-purposes. Like the state (and we will have to keep an eye on this relation), prediction adds a stabilizing dimension, perhaps facilitating the extensive prolongation of the capitalist process (i.e., its survival of itself over time). But it may serve other forms of stasis or stability as well, precisely where things have grown dynamic, complex, and uncertain. Real-time or just-ahead anticipatory insights into the dynamics of a large-scale system with many moving parts can enable a precise responsiveness to local and aggregated needs, problems, and opportunities that may be difficult to achieve otherwise. And indeed, this is an area where AI development is in full swing. In California, one ambitious initiative is the Grid Resilience and Intelligence Project (GRIP) underway at Stanford University's SLAC National Accelerator Lab since October 2017. Granted $6M over three years from the US Department of Energy, with another $1.6M from industry, the project aims to develop artificial intelligence tools to (1) predict disruptions to the grid in advance, (2) more readily absorb potentially disruptive events (such as by "virtual islanding," or temporarily dividing a grid into micro-grids in order to quarantine disruptions), and (3) recover more quickly from disruptions when they do occur – all with "minimal interventions from humans."[112] The list of potential disruptions that GRIP has in mind is wide-ranging: power fluctuations (such as those due to intermittent energy sources), storms, solar eclipses, cyberattacks, and vegetation growing over power lines (which they plan to track

[112] Glennda Chui, "SLAC-Led Project Will Use Artificial Intelligence to Prevent or Minimize Electric Grid Failures," SLAC National Accelerator Laboratory, September 14, 2017.

using satellite imagery). The project has secured partnerships to test its platform with universities, Tesla Motors, and, notably, Southern California Edison, along with at least two other unnamed utilities in Vermont and the Midwest. The plans for GRIP's eventual output are somewhat ambiguous: while the principal investigator claims that the code will be open source "so a lot of academics can develop tools they can test on the platform," the project also appears to intend to release its largely publicly funded research as a commercial platform. Another of their major partners is the National Rural Electric Cooperative Association (NRECA), "which represents more than 800 cooperatives that supplies [*sic*] electricity to something like 42 million people in 47 states." NRECA members are cooperatively owned organizations for the generation and/or distribution of electricity that are a long-standing residuum of the 1936 Rural Electrification Act, which aimed to electrify regions of the countryside that privately owned utilities viewed as unprofitable (see Part I). While it appears that GRIP intends to make its platform openly available to at least some NRECA members for validation and testing purposes, their press releases to date are (perhaps strategically, a cynic might suspect) vague about whether they include the other ~800 cooperatives in their prospective commercial market.

Infrastructural stability is not necessarily a bad thing, even if it has to be paid for. And it will no doubt prove interesting to see whether and how rural electricity cooperatives are able to put artificial intelligence to use to advance their own energetic and political agendas. More broadly, there could be reason for cautious hope that predictive techniques might provide ways of addressing problems that have long plagued the socialist-communist imaginary and bolstered its critics. As Morozov writes:

> From the 1920s, in what would later be known as the Socialist Calculation Debate, Mises and Hayek had famously argued against their left-wing adversaries

> that it was the absence of the price system that doomed socialist central planning. Lacking real-time insights into the shifting tastes of consumers, most advantageous deployments of resources and fluctuating supplies of intermediate commodities, central planners stood little chance of adjusting their models fast enough to keep up with the rapidly changing world.[113]

It is just this potential for real-time information and (re)distribution that predictive techniques incubate at the bleeding edge of capitalist innovation. Although today these systems nearly always fall back on the mechanisms of price, private property, and the boundaries of corporate entities, might they also form an important component of an alternative, essentially resolving the aporia that Soper observes in Marx's conception of human needs under communism? This certainly warrants further exploration, above all in practice. There are, however, at least two considerations that may advise a more critical approach. One, which follows from the argument of Part I, is that at some point it becomes necessary to ask what is being stabilized, what rhythms and patterns of intensity are being held in place. Must every desire be met, even if it means stretching the capacities of the earth, and this in ways that provide new terrain for the reproduction of capital? (Recall the abolition of night, its correlation with the extension of the working day, etc.) Soper's argument is that needs and patterns of consumption are irreducibly political questions, that political decision and critique are necessary here precisely because needs and what it means to meet them are not fixed by natural law, to be "solved" by straightforward objective analysis and technical solutions.

A second reason follows from the argument of the present chapter. As the cases of GRIP and the California electricity crisis show, prediction, and perhaps above all the massive amounts of information that are required for such schemes, readily provide their own new terrain for capitalist accumulation and speculation, threatening to run in a line

[113] Morozov, "Digital Socialism?" 35.

of flight away from production based on use value. As Morozov notes, some critics have argued that the kind of data-driven "planning" employed by modern behemoths like Amazon and Walmart, far from enabling social planning in a good sense, actually introduces greater noise and uncertainty – i.e., that "Big Data clogs the operation of the price system." It has even been claimed that "the price signals of today's data-saturated markets, where sovereign-wealth funds and deep-pocketed tech platforms subsidize services to the point where no one really knows what they cost, resemble those of the Soviet system in the years before its final breakdown."[114] And of course, capital is always ready with techniques of arbitrage and other forms of speculation to recapture these decoded and uncertain flows.

This *excess* of information bears further reflection. As described earlier, problems of distribution, of what goes on in the conditioning aftermath of production, require a recording or accounting process – an inscription adjacent to or standing apart from productive labor and the movements of energy. As Ian Hacking tells it, the very existence of the science of statistics that developed into today's predictive techniques was the historical result of an excessive recording and accumulation of data about populations collected by state administrations of the 19th century.[115] At first, such data were not always collected with explicit purpose: in Prussia, early statistics bureaus often employed amateurs with a mania for collecting figures about sundry topics, intuiting that such a fetish could prove useful to the affairs of governance. It was only later, after other states had followed suit, that mainly French mathematicians developed robust techniques of statistical analysis, and statistical thinking about populations emerged in full. The result

[114] Ibid.

[115] Ian Hacking, *The Taming of Chance* (Cambridge, UK: Cambridge University Press, 1990).

was nothing short of the birth of a new kind of "law," autonomous from the billiard-ball determinism that had predominated the concept of natural law. Statistical law described patterns, distributions, and limits of variation that emerged in the aggregate from individual traits and behaviors. These measures were used not only to predict regularities, but also to alter the conditions that produced the patterns, thereby improving the aggregate; such a concept of law was mutable, emergent, agnostic to the fact-value distinction, and describable only at the distance of mathematical abstraction about large aggregates. These techniques, and the "avalanche of printed numbers" that preceded and spurred their development, became the foundation for a whole new wave of state reasoning about population health, crime, heredity, interest rates, and more.

Under what conditions, then, might recording, information, and prediction facilitate forms of planning that are truly anticapitalist, that reorient decisively around matters of use value and do not run off to establish their own dominating logic? Exchange value as socially necessary labor time always meant that value is an accounting system for labor, a runaway inscription circulating in alienation from the energies of the body that it represents. Contemporary capitalism thrives on an excess of recording, using the terrain created by the registration of new processes, sub-processes, and linkages between processes as new factors of production, adjacent to the often indifferently or unknowingly recorded actors. As Mark Hansen writes:

> [T]oday's data industries operate on the basis of a system of information gathering and analysis designed to leave citizen-consumers out of the loop. A case in point is contemporary social media, where the affordances of particular platforms are ultimately nothing other than "lures" to generate activity, and hence data, that fuels a predictive engine for the production of surplus value.[116]

[116] Mark B.N. Hansen, "Our Predictive Condition," in *The Nonhuman Turn*, ed. Richard Grusin (University of Minnesota Press, 2015), 113.

What would it mean to close or reconfigure this loop in the case of electricity? Is it a matter of bringing these infrastructures back into consciousness, of not allowing them to disappear into the background? Is it a question of who owns the recording and distribution channels of energy and information? Or are there other ways of thinking about repairing this alienation, this rift between energy and information? If we have any clue so far, it is that the question is irreducibly about large aggregates and the means of controlling them, or how they can control and plan themselves. Is planning always something adjacent to the process, or can it emerge immanently? Perhaps a dichotomy is not the best way to frame the matter: in practice, it is a question of one tendency holding and feeding back on another, like the Watt governor regulating the speed of a steam engine. A governance machine.

Planning 1: Seizing the means, or overcoding

Where an aggregate is assembled, planning is on the horizon. So is law: both the apparent emergence of new quasi-natural laws and the possibility of governing by decree. Somewhere among the whirring of the social machines, a power, authority, and surplus-appropriating vector that transcends and governs them is produced. When does this occur, at what point in the process? We know that it is secondary, a parasite or appendage of production, but beyond that things become complicated. Even (and perhaps especially) for Lenin, who tried to seize direct hold of the state both practically and theoretically, its nature proved mercurial and difficult to grasp. Its power was nevertheless clear, if ambivalent: as an intermediary between struggling classes, competing elements, and a diversity of needs, the state exerts an influence on the dynamic of their coordination, either maintaining stasis or pushing actively to shift the

aggregate in a new direction. In either case, all manner of techniques and apparatuses can be employed (including statistical calculation and prediction), but here they are subordinated to a definite goal; and, when the goal is not contained within the present, there is genuine planning and futurity. This mode of planning institutes a break: despite the past, it says what the future will be. If prediction mobilizes an outcome "passively," aiming to convince with its assuring rhetoric of certainty, state or central planning does so "actively," by setting enormous energies to work and compelling movement in a certain direction.

But the state has two moments, and is consequently always ambiguous between two aspects. There is an overcoding power of compulsion concentrated in a central authority, but there are also the gathering and linking factors that establish the fact of aggregation and the lines of force along which authority can become effective. Deleuze and Guattari problematize this duality explicitly, though briefly. After describing the despotic state formation that runs roughshod over existing elements (corresponding figuratively to the feudal sovereign), they distinguish another element, subtly but importantly different from the first, which is the State proper or "Urstaat." The Urstaat is "not one formation among others"; it is not a distinct "stage" of history, but is "on the horizon throughout history," a permanent possibility of society (like capital, in that respect). Unlike actual historical states, which may rise and fall over centuries of power struggle, the Urstaat appears as a "master stroke executed all at once," the transcendental ideal of the State born "in the brain of those who institute it."

> It appears to be set back at a remove from what it transects and from what it resects, as though it were giving evidence of another dimension, a cerebral ideality that is added to, superimposed on the material evolution of societies, a

> regulating idea or principle of reflection (terror) that organizes the parts and the flows into a whole.[117]

This primordial, ideal State then itself has two aspects: an overcoding tendency, and a tendency to "fashion as best it can a whole to which it will render its law immanent," so that it is "itself produced inside the field of decoded flows."[118] In liberal democratic states, where the despot is weakened to a shadow of its former power, this is of course the self-disavowing mode of governance described by Foucault as governmentality: the state becomes occupied increasingly with accounting and surveying commodity flows, which are treated as quasi-natural laws of the market.

For Deleuze and Guattari, this moment in which the state attempts to become a governance machine immanent to the quasi-nature of things is also the moment in which the State becomes immanent to desire — where desire desires its own repression by the great uninterruptible stasis. I have already shown in Part 1 how, in the case of the California grid, the state joins up with desire in a paranoid war with intermittency and uncertainty in the electrical supply, using the limited weapons left in its arsenal after deregulation: overinvesting in new generation capacity, and guaranteeing rates of profit to utility investors. These are clumsy tools of planning, reducing flexibility, increasing pattern lock-in, and thus generally opening themselves to all the well-known critiques of state intervention (including the arguments that led California to deregulate in the first place). Although a centrally planned energy economy there seems nowhere in sight, the state still musters its strength to uphold the imperative that the smooth spacetime of electric ubiquity face minimal interruptions. It stabilizes a steadily growing intensity, divorced from the rhythms of the earth, that becomes a new substrate for myriad social

[117] *AO*, 217–19.
[118] Ibid., 221.

processes. The state inserts itself to ensure that the demand for this particular use value is met. On whose behalf? The need or desire for ubiquitous electricity is no longer that of a particular class, but is almost invested by the socius as a whole. The desire for this great electrical ur-Stasis conditions most attempts to leave the centralized mode of generation behind, recomposing itself now on the system of transmission and distribution (e.g., localized solar remaining connected to the larger grid); the spectre of the stock haunting the wires and cables of the flow. Thus, even beyond the ideal elements that make breaking away from this aggregate almost unthinkable and introduce the appropriate forms of rational management, something akin to the primordial State is embodied in quite material infrastructures like the grid, which may long outlive the composition of particular political formations.

I have already described how the frequent description of solar and wind generation as "decentralized" is in most cases somewhat misleading, referring primarily to economic ownership, although this is not nothing. For present purposes, I will simply further note that their remaining dominated by the structure of the macro-grid is what also enables centralized planning and control, for better or worse. Largely as a result of the exigencies of managing intermittent sources, an increasing amount of industry attention is focused on what is called "demand response," i.e., attempting to shift or "nudge" consumption patterns to balance the load in a way that more closely tracks with a strongly rhythmic and/or unpredictable availability of supply. It may also seek to directly compel greater efficiency and usage reduction. Demand response profiles can be left purely to the market, enabled by real-time and predictive monitoring, or they can be mandated by central authorities on local, regional, or national scales. The latter may offer

a "middle ground" alternative to the long-term contracts discussed above: some have argued that consistent time-of-use pricing may be preferable to pricing based on real-time market fluctuation precisely because it allows for better aggregate planning.[119] But, today at least, the method of nudging is nearly always a price incentive; "demand-side participation" and "energy democratization" constantly rebound against this limit. Not only does this mean that social planning is recaptured by capitalist forces, but also that it becomes a trivial matter to automate things away from the social and from consciousness altogether. Witness the birth of the so-called "internet of energy": networked appliances sharing real-time data with the grid, balancing load forecasts, recommending patterns of daily activity planning based on cost and environmental impact, and making purchase agreements or trading on energy futures, all on their own. Your toaster as stockbroker, foreman, and moral accountant — just eat your toast and hope for the best.

There are times and places where stronger interventions are possible. I have previously described how early American electrical companies worked to foster a new "positive electrical consciousness" in an effort to improve their demand curves, and all the great quasi-socialist schemes to bring power to the countryside could be seen as similar attempts to foster new patterns of desire, this time for the elimination of drudgery and darkness.[120] Lenin had something similar in mind when he made his famous declaration: "Communism is Soviet power plus electrification of the whole country." In

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[119] Jacopo Torriti, Matthew Leach, and Patrick Devine-Wright, "Demand-Side Participation: Price Constraints, Technical Limits and Behavioural Risks," in *The Future of Electricity Demand: Customers, Citizens and Loads*, ed. Tooraj Jamasb and Michael G. Pollitt (Cambridge University Press, 2011), 95–6.

[120] Beyond the REA, the history of the failed proposals for "Giant Power" in the United States is a fascinating episode. Spearheaded by Gifford Pinchot and Morris Cooke in the aftermath of WWI, Giant Power was to be nothing less than a "social revolution," wresting control over the nation's energy supply from private interests. It was opposed as a "socialist plot" and eventually defeated. Hughes, *Networks of Power*, 297–313.

the aftermath of the successful Revolution of 1917, Lenin found himself at the helm of a political state whose infrastructure did not match the State in his head. He understood that without widespread electrification, there would be neither sufficient industrial production to realize the required material abundance, nor sufficient material and cultural parity between the city and the countryside, for a self-sustaining communist economy and nation-state.

> Without this reconstruction of all industry on lines of large-scale machine production, socialist construction will obviously remain only a set of decrees, a political link between the working class and the peasantry, and a means of saving the peasants from the rule by [anti-communist forces]; it will remain an example to all powers of the world, but it will not have its own basis.[121]

But Lenin's concern for self-sufficiency here is decisively on the aggregate level, rendering smaller scales dependent on the whole. In another speech from the same period, he describes uprooting existing forms such as small markets and peasant agriculture, which were seen as giving way too easily to the reimposition of capitalism:

> Anyone who has carefully observed life in the countryside, as compared with life in the cities, knows that we have not torn up the roots of capitalism and have not undermined the foundation, the basis, of the internal enemy. The latter depends on small-scale production, and there is only one way of undermining it, namely, to place the economy of the country, including agriculture, on a new technical basis, that of modern large-scale production.[122]

It is at points like this that it becomes most important to read Lenin carefully and in context, as a political figure operating within a particular set of material conditions and responding to rapidly changing exigencies on the ground.[123] But the ambiguities that arise

[121] V.I. Lenin, "Our Foreign and Domestic Position and Party Tasks: Speech Delivered To The Moscow Gubernia Conference Of The R.C.P.(B.) (November 21, 1920)," in *Collected Works, Vol. 31*, trans. Julius Katzer, 4th ed. (Moscow: Progress Publishers, 1965), 408–26.
[122] V.I. Lenin, "Eighth All-Russia Congress of Soviets, Part II: Report on the Work of the Council of People's Commissars (December 22, 1920)," in *Collected Works, Vol. 31*, trans. Julius Katzer, 4th ed. (Moscow: Progress Publishers, 1965), 461–534.
[123] For an excellent treatment of the subtleties and difficulties of interpreting Lenin at various stages in his career, see Lars T. Lih, *Lenin Rediscovered: What Is To Be Done? In Context* (Haymarket Books, 2008). Note especially the discussion of Lenin's alleged relation to the

here are also where he is most theoretically interesting. In *State and Revolution*, we see him come up directly against the dual nature of the state, and yet despite his analytic clarity here it is hard to avoid the impression that he is somewhat vexed by it. Against the anarchists, immediate transition to communism is impossible; only the compulsory power of the state can bring it about, and it will take some time. Therefore the state must be seized – but, immediately transformed into something completely different:

> [I]f the state is the production of the irreconcilable character of class antagonisms, if it is a force standing *above* society and 'increasingly separating itself from it,' then it is clear that the liberation of the oppressed class is impossible not only without a violent revolution, *but also without the destruction* of the apparatus of state power, which was created by the ruling class and in which this 'separation' is embodied.[124]

He insists repeatedly that the dictatorship of the proletariat is not simply a new class occupying the same old state, but a *sui generis* form, owing to its majoritarian composition and an attempt to minimize bureaucracy. One could be forgiven for thinking that his nuanced dialectical account obscures a moment of pivotal indecisiveness on these points. But things become much clearer if we read him, along the same lines that Deleuze and Guattari suggest, as distinguishing two senses of the state. There is on the one hand the state of compulsion, relying on a standing army and the police; on the other hand, there is the almost purely technical state of "accounting," "management," and "control." This second state he proposes to keep after the transition, although he sees that its form is not neutral and that it cannot simply be taken over as is. Improvements in technology and management must be made such that these functions are simplified enough to be carried out by nearly anyone, without a specialized class of technical labor. Where the latter is unavoidable, such functionaries are to be stripped of any special prestige, directly elected

concept of "spontaneity" (pp. 613–28).

[124] V.I. Lenin, *State and Revolution* (International Publishers, 1943), 9.

and immediately recallable.[125] The picture is vivid and almost idyllic. But in the meantime, knowledge divisions run riot, and old habits of capitalism die hard. Until habits of communism can be learned, "the Socialists demand the strictest control, by society and by the stat*e*, of the quantity of labour and the quantity of consumption."[126]

This is the role that demand response, time-of-use pricing, and all the rest can play, and perhaps should; after all, the ecological crisis may need a "regulator," a governance machine to prevent certain thresholds from being crossed. But one cannot help but to feel that this approach leaves something lacking, and to hope for a different kind of vanguard to teach a different practice. At this point, we do well to remember what was supposed to make the proletariat a unique revolutionary class in the first place. Lenin himself puts it well:

> While the capitalist class breaks up and atomises the peasantry and all the petty-bourgeois strata, it welds together, unites and organises the town proletariat. Only the proletariat – by virtue of its economic rôle in large-scale production – is capable of leading *all* the toiling and exploited masses, who are exploited, oppressed, crushed by the bourgeoisie not less, and often more, than the proletariat, but who are incapable of carrying on the struggle for their freedom *independently*.[127]

What could this revolutionary independence and self-sufficiency mean in the present context? If we think this only from the perspective of material wealth, with a certain formation of needs given and immutable, then there may not turn out to be quite any such class today, almost certainly not in the case of energy. We may have to move up a level: what are the conditions under which we could build or discover enough capacity to produce life that it becomes possible to issue the "we don't need you" that has always been the cry of the worker's movements? What evidence, example, or proof of concept

[125] Ibid., 97.
[126] Ibid., 80.
[127] Ibid., 28.

could bear the hypothesis, eminently reasonable under conditions of conspicuous abundance, that anyone selling you precarity is lying? It is to a form of planning based on this hypothesis that I now turn.

Planning 2: The rejection of precarity

The aggregates are not the problem (though this does not mean that scale is always a friend). Lenin is not wrong to look for a notion of self-sufficiency that goes beyond the atomic individual. Disaggregation works just as often as a tool of neoliberalism and authoritarianism;[128] more precisely, it is never a question of one or the other, but of how the two mediate each other (gathering wholes and breaking off parts). It is too late to think in terms of simple oppositions and counter-conducts: to say that we are at stage A and moving to ~A, or that power wants me to do B so therefore I will do ~B. The proper response to prediction is not to simply become unpredictable, for only the most rigidly stable infrastructure, the most uniformly reliable capacitation, can sustain the truly unpredictable for long. Rather, what is needed is planning; it is still a question of

[128] For example, it can be used to disrupt informal economies that depend on a degree of collectivized anonymity. And AI can be put to this purpose as well. In parts of India, electricity theft is common via illegal hookups to power lines (detachments from a prior amassment). The practice is so common that it has long been tolerated by electricity providers, if only because they have had no reliable way of tying thefts to particular people or even neighborhoods. There is increasing interest in tightening up these losses, which are substantial: while losses of a few percentage points are common in electrical transmission, it is estimated that up to 30% of electricity generated in India is "lost," most of which is due to "non-technical losses," e.g. theft; see Miriam Golden and Brian Min, "Theft and Loss of Electricity in an Indian State" (International Growth Centre, 2012), 12. Machine learning applications are in development that can analyze usage patterns to more precisely localize cases of unpaid activity, and thus crack down on them for payment. For an overview of the AI technique, see Patrick Glauner et al., "The Challenge of Non-Technical Loss Detection Using Artificial Intelligence: A Survey," International Journal of Computational Intelligence Systems 10, no. 1 (2017): 760–775; for work specific to India, see B. Dangar and S. K. Joshi, "Electricity Theft Detection Techniques for Metered Power Consumer in GUVNL, Gujarat, India," in 2015 Clemson University Power Systems Conference, 2015, 1–6.

what planning means. Perhaps centralization vs. decentralization is not the right question either, or not enough. With Lenin, we can affirm that what matters is less a matter of choosing this or that form (as if one were ever presented with a choice of social systems so neatly packaged), and more a matter of a break, and what comes in in its wake. Seizing the grid and overcoding the flows is one way to go, or one prong of an approach. But to lay my own cards down: in California and places like it, I am not hopeful (which is not the same as not hoping). This is why I find myself oriented toward other kinds of breaks, toward the breaking down that is going on all the time. What kind of planning takes place, or could take place there, "in the play of the general antagonism"?[129] Like capital, such play occupies a kind of non-time, but concrete instead of abstract: a rhythm of the everyday and every night.

Perhaps solar power does not meaningfully decentralize energy economy on its own, perhaps all the forces are already in place to recapture its potentials for the status quo and make the notion of "participation" a farce. But perhaps it provides enough people with just enough of a shadow of autonomy to reopen the question of energy as a social practice. Not simply because individuals and small collectives can have an ownership stake or "interest," but because the material dynamics are such that making full (or even reasonably functional) use of it requires thinking about how various activities are distributed throughout the day; i.e., how we fill our time, not as a matter of individual choice, but of rhythms taking shape in the aggregate. Again, this can be directed from the top down, but taken alone this approach leaves all of the old desires and subjectivities intact; no matter that people render themselves malleable according to the

[129] Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning & Black Study* (Minor Compositions, 2013).

fluctuating commands of the market, because this is a form of contingency and uncertainty they know all too well. Decarbonization is a deeply worthwhile project on its own, but it will still be a missed opportunity if pursued in isolation.

Thus it is perhaps appropriate that the best articulation of the alternative form of planning I am gesturing at comes out of a different struggle and set of concerns. Harney and Moten's *The Undercommons* is, among other things, a manifesto for a "post-scarcity" politics that does not depend absolutely on the development of material wealth. It is solar in orientation in that it insists that the abundance that matters is always close at hand. It rejects the notions of lack and precarity as always coming from the outside, secondary to the actual process of producing life. Its key site is social reproduction and informal invention:

> [Planning resists] every effort to impose a compulsion of scarcity through seizing the means of social reproduction. In the undercommons of the social reproductive realm the means, which is to say the planners, are still part of the plan. And the plan is to invent the means in a common experiment launched from any kitchen, any back porch, any basement, any hall, any park bench, any improvised party, every night. This ongoing experiment with the informal, carried out by and on the means of social reproduction, as the to come of the forms of life, is what we mean by planning; planning in the undercommons is not an activity … but the ceaseless experiment with the futurial presence of the forms of life that make such activities possible.[130]

This kind of planning says: we have enough, are enough, don't need you. It is "self-sufficiency at the social level," through social means.[131] This sounds right, but what could it possibly mean for energy economy and something like a communist response to climate change? Harney and Moten's remarks on planning are brief and gestural, and mine will be similar in that respect; nevertheless, a slight extrapolation from their ethos

[130] Ibid., 74–5.

[131] Ibid., 76.

leads to a number of interesting intersections and new angles with respect to the foregoing discussion.

The first question is the significance of the social. In asking after social practice, it is easy to think that one would be limited to "practices of consumption," and consequently to tinkering at the margins with new uses and modes of experience of electricity. I have downplayed this dimension throughout this project, because I am interested in something more infrastructural (and because I think such a strategy is truer to the actual experience and significance of electricity in cases where it is already well-established). I believe Harney and Moten are also asking after something infrastructural when they distinguish between activity and what makes activity possible; they are concerned with building and sustaining a kind of capacity. For me, in the present context, this is the capacity for social practice to matter infrastructurally. As indicated above, this may be the real possibility opened by solar and related forms, although getting to such a point fully may require real structural change and struggle, i.e., anything but tinkering at the margins (again, the various forms of planning are not mutually exclusive). A second point that emerges here is that, while experimenting with alternative consumption may not be sufficient on its own, being willing to consume differently vastly expands the palette of possibilities. I have repeatedly emphasized how the unwillingness to countenance intermittency or strong rhythmicity in the electricity supply is a major factor holding present dynamics in place.

The second question, then, is scale. Of course, if one has no problem with intermittency, one can easily go off the macro-grid completely and declare self-sufficiency with a few solar panels. There is nothing wrong with this, and I see no reason

not to support secession as an option. But for most people, perhaps, it fails to answer the question; not just because intermittency is difficult to live with, but because the point is to invent modes of living collectively, and with the degree of reliability that characterizes (the positive aspect of) infrastructural relation. So what kinds of practices, particularly practices of distribution, are available if we start from the assumption that many people and communities have access to a certain amount of generation capacity? If we don't trust the market, could scale and relative stability be achieved with something like a gift economy? Of course, if such an economy is to be based on a conception of needs, then these must in some way be politically decided upon, accounted for, and balanced against each other. But a solar orientation demands that we do not start from a perspective of scarcity; on the contrary, it suggests starting from a Bataillean overflow, where there is always too much for anyone to hoard, and the central problem is how to channel this excess. Is there a point at which I could give myself over to this dynamic without being rendered precarious by it? Where I could trust that my needs will be met, not by the generosity of strangers, but on the contrary, by their own need to give something away? Could this principle of waste, excess, and the diversity of needs be the key to a sustainable informality? In an interview included in their book, Harney describes a similar position on the question of scale:

> [U]nder what circumstances could I allow myself to be taken up and possessed by others, be in the hands of others, give up anything like a kind of sovereign self-determination that I will vote on every decision, that I will oversee, that I will be like Lenin's inspectors … What kind of communism could there be where I could just allow some people to do some shit for me, at the level of scale, and at the same time those people would also at other moments allow me to be doing that kind of thing? So, in what ways are practicing, when we're for a dispossession of ourselves … allowing ourselves to consent not to be one, at a moment that also

> lets people act on us and through us, and doesn't require us re-constituting ourselves.[132]

In other words, build the community, and you will already have the principle of elaboration that will produce the scale; it is not a matter of finding ways to translate the small into the mode of registration of an existing overseeing body, but of composing a new aggregate on its own basis, principle, and rationality.

All very well, but how is it actually *planning*? There are aspects of the answer that will have to be invented or discovered in practice, but we do not have to start from scratch every time; rather, the point is to discover what is already going on. The sun, for example, already gives us a rhythm. Rather than try to flatten out and cover over this rhythm, what if it became the place for an alternative economy/ecology to gain a foothold? The idea is not after all so new; recall that for Marx, a central site of struggle against capital, or at least the birthplace of the consciousness of the capitalist theft, was the cycle of the working day. Why not shift as much industrial activity as possible into the middle of the day, when the solar excess is at its peak? This seems like a potent area of connection between energy and labor movements. Of course, the difficult complication today is the vast expansion of leisure activities, but these could at least at first be served by non-solar means. Storage would also be helpful here again; the question, however, is how to imagine uses of storage that do not simply recompose the flat time of fossil fuels. Here's a crazy plan: rather than think of the night as a time of lack, could it be conceived as a time of potlatch, an inversion of the potlatch of industry during the day? The game would be to prevent accumulation and stockpiling, to use storage as a temporary point of redistribution rather than to lock up the flow. Perhaps excess energy stored during the day

[132] Ibid., 145–6.

could be taken freely at night, by gift or theft. For this to work, the means of distribution and storage may have to be seized and socialized. Countless details remain to be worked out, and it is only one plan among an infinite variety possible. Still, the point seems to be this: by leading with the excess generated by reconceived social practices, by finding the ground on which what is already happening is the common soil for the interconnection of struggles that the world has convinced us are disjoint, it may be possible to conceive of a "participation" in energy that goes beyond penny-pinching austerity and the kind of abstract and shallow moralizing that leaves us feeling always already guilty and defeated.

Conclusion

Throughout this project, I have emphasized that attending to the properties of energy sources as materials of production, while an important part of the story, is not a sufficient framework through which to think the political economic and ecological implications of energy infrastructures like electricity. As any Marxist will tell you, of course, relations of production are also crucial; I have thus repeatedly described the irrationalities that capital introduces in subordinating production and the meeting of needs to production in another register, that of surplus exchange value. Infrastructures in the form we call "utilities" do inherently embody a contradiction between use and exchange value, and this is indeed what opens in them a glimmer of a utopian dimension and makes them productive to think with. But questions persist even if this particular contradiction is resolved. Relations of distribution and consumption, embodied in part in forms of infrastructural mediation, become crucial to explain the dynamics of how the different moments of the processual totality of production or social metabolism are held together and apart within a given formation. If electricity creates an abstract stasis that widens the rift of our alienation from the underlying flux, what else comes rushing into this gap, and with what effects bleeding out into other spheres? As we have seen, it opens space for the reterritorialization of property relations. It summons new rounds of extractive mining and processing of materials to build solar panels and wind turbines. It fuels new engines of financial speculation on the earth's future. It potentially makes us beholden to a technical division of labor in which machines and/or a specialized class of humans are solely responsible for mediating our energy metabolisms, and the vast

majority of us are left ignorant and powerless. For all that, it is probably not going anywhere. So, what must change?

It is not only a question of material abundance being held back by the axiomatic profit imperative of capital, although clearly this is a major driving factor. Our present situation is one in which it is not only technical infrastructures that have been ravaged by neoliberalism, divested and left in shambles. Prospects for material and technological abundance have only improved since 1968; what has perhaps continued to deteriorate most rapidly is a certain social capacity, and feeling thereof. It is in this context that I find Harney and Moten's reflections on inventing the means of social reproduction most illuminating. Their articulation of a communism that rejects the imposition of scarcity through "consenting not to be one" (as they borrow Édouard Glissant's phrase) is a powerful call to work against the fragmentation of sustaining ecosystems and relationships. From this perspective, the energy question is not simply about the ownership and distribution of a good, even a particularly "needed" one; in fact, as I have discussed, electricity has long been envisioned and employed as an equalizing factor amidst other unequal distributions of wealth. It is, ultimately, a question of whether such distributions, redistributions, and excesses of energy can be channeled into sustaining the infrastructural capacity of ecosystems social and otherwise to support life. Bookchin and his generation may have been correct to view the despotic monolith of the state as the chief danger to be countered in their time. While deciding how to engage with the state and all the rest remains indispensable, such questions are perhaps secondary to rebuilding this social infrastructure today.

If we follow Deleuze and Guattari a moment longer, it would seem that the question before us is how to compose a new socius beyond capital. Perhaps there is a sense in which the earth must once again appear as the conditioning ground of all that flows on its surface, in which it is not only the source of "free gifts of nature," but the surplus-appropriating vector toward which all must return. But the question cannot be posed as one of "going back," for a reason that goes beyond arguments about the desirability or undesirability of particular historical conditions. The problem is the false certainty that such politics engender: as I have described, the assumption that revived and repeated images of the past will remain workable is the very method by which predictive techniques lay claim over the future (and is likely to prove as conservative and infeasible in the present context). On the contrary, what Deleuze and Guattari suggest is that such forms of organization are always secondary effects, which cannot be foreseen until they have already snapped into place. To paraphrase a favorite saying of Deleuze's from Spinoza: *we do not yet know what a socius can be*.[133] The seeds or atoms of another way may already be present in overflowing abundance; perhaps they have only to be assembled and held in the right sort of plan, to make it through the coming night.

[133] Cf. Gilles Deleuze, "What Can a Body Do?" in *Expressionism in Philosophy: Spinoza*, trans. Martin Joughin (Zone Books, 1990), 217–34. The original is from Spinoza, *Ethics*, III.P2s: "No one has yet determined *what the body can do*" (quoted in ibid., 383n4).

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