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[00:00:00] **Nate Hagens:** Good morning. On last week's Frankly, I outlined how we are likely nearing the end of a mega-anomalous historical period of economic growth measured by material throughput, enabled by the energy surplus from fossil hydrocarbons, extended and made invisibly fragile by the social technology of debt.

[00:00:28] As longtime viewers here know, I have quite a bit of certainty about the components and logic of how all this fits together, but far less certainty on what do we do now. And where I land on that is two things. Number one, changing the initial conditions of the future in ways that we can't yet articulate or even know.

[00:00:53] And two, my deep trust in informed and engaged humans on the scout team of the more than human predicament, many of you watching this show, to respond in emergent ways in the future. But there are things we can know or at least infer about the inevitable peaking and eventual decline of the surplus enabled by the carbon pulse, which in turn imply and infer the buckets of what do we do now.

[00:01:32] So many of the rules during the upslope of the carbon pulse over time have kind of become culturally perceived as natural laws. They're gonna undergo phase shifts on the downslope. Yes, the circumstances and the biophysical backdrop will change, but so will the rules of what humans do. And today I wanna speculate on how the downslope of the carbon pulse may have decidedly different rules than the upslope, because perhaps thinking about and discussing these will offer us some advance foresight for broader interventions and such.

[00:02:19] I think these rules are merely directional, and they're gonna arrive, coming at us at different speeds and in different places. And I think the transitions between the old rules and the rules of the downslope are both where the trouble is and where our work resides.

[00:02:50] Okay, rule number one. I will start with an example of how an upslope rule completely changes on the downslope, and it involves the maximum power principle, which I've covered before. The short version of that is nature does not try to conserve energy. The organisms and ecosystems that win are the ones that capture and utilize the most energy they can get.

[00:03:17] This was originally Alfred Lotka a hundred years ago and H.T. Odum, and I've personally leaned on this concept for years, decades. Viewers here are also quite familiar with Jevons paradox, where a system-wide improvement in technological efficiency actually paradoxically increases overall energy use because in a growth environment, the savings from the tech then get spent on something else. It's why three centuries of consistent innovation in lighting technology has never once reduced global total energy use by humans for light.

[00:04:07] We just got more lit during those centuries. But here's a part of this phenomenon that I've kind of glossed over. The maximum power principle only suggests that whatever captures the most available energy wins. People, including me, kind of categorize that as waste wins. But what capturing the most energy looks like depends entirely on how much is available in the environmental circumstances.

[00:04:42] When there's a surplus, capturing the most means growing fast and burning it indiscriminately. Like algae that explodes across a pond in the days after fertilizer washes in, or a business startup burning cash in order to grab customers before anyone else does. So the Jevons rebound effect is this same behavior society-wide.

[00:05:13] However, when the surplus is gone, capturing the most available energy means something very different. It means squeezing the most work out of a smaller energy flow. So not only has the winning strategy changed, but it's actually flipped. And we see this in nature: in the desert, the kangaroo rat that never takes a drink, or a cactus that stores, like, a year of water.

[00:05:47] An old growth forest wins by recycling almost everything. In contrast, the pond algae eats all that immediate energy right away. A black bear survives the winter by cutting its metabolism by over seventy percent and then living on what it has stored. So H.T. Odum, who was my PhD advisor's PhD advisor, referred to this phenomenon in nature as pulsing.

[00:06:17] Systems surge when energy is abundant and then shift to conserving when energy gets more scarce. And usually, often, it is the conservers that are the ones still there when the next surge comes at the other side of the pulse. So on the downslope of the carbon pulse, the energy savings in society will still get spent. What changes is what they go towards.

[00:06:49] On the upslope, those savings were spent on the next thing: the bigger house, and the dopamine bling, and the Halloween costume for the dog. Fresh in my mind 'cause there were some dang funny ones on Twitter this weekend. On the downslope, though, the savings themselves act as the surplus that allows us to keep the furnace turned on and food on the table and such, because the easy surplus in society that used to cover those things is now gone.

[00:07:28] So I think the implied rule change from upslope to downslope is: the efficient household or town or region is the one that has margin for basic needs and essentials, and the wasteful one won't have such a margin. And I think from an ecological perspective, there's an interesting corollary here: Jevons paradox was never really a law.

[00:08:03] It was just the maximum power principle being expressed under a growth phase in a pulse. So on the downslope, we're gonna see the same principle expressed in the other phase, where efficiency actually gives us a boost instead of a rebound. So the saved energy goes to things like staying alive instead of towards growing.

[00:08:37] That's pretty complex, and I think I'll cover this more in a future Frankly. But as an aside, those engineers today who are obsessed with efficiency and the importance of efficiency, they're not wrong. I think they're just at the wrong inflection point of the carbon pulse slope for efficiency to be the major driver or even that important.

[00:09:01] But it will be important. Okay. The next downslope rule sounds like it contradicts what I just said, but it's different. So there are two things that we call efficiency. One is getting more useful work out of every unit of energy, and I expect this is gonna be culturally rewarded on the downslope.

[00:09:28] The other is the strategy of what business schools call running lean, cutting every buffer and reserve because from the profit-maximizing spreadsheet perspective, these things look like waste. This lean manufacturing, I think, is generally going to be punished on the downslope. On the upslope, the smartest thing we, AKA individual humans and businesses, can do is run lean.

[00:10:01] Just-in-time, no inventory, no spare capacity, because the societal surplus measured by us in stored dollars lets us buy our way out of any external shock. But on the downslope, buffers, which is kind of a sacrilege in a growth-based system, may be the difference between a very uncomfortable few weeks and a calamity or even an outright collapse.

[00:10:32] Buffers would be things like duplicate spare parts or stored food or backup suppliers or vendors. These things are gonna turn out to be instrumental

to a community, a system able to absorb a shortfall and then keep going. And I didn't realize this, it's taken a while, but this is what Olivier Hamant meant on our podcast by robustness over efficiency.

[00:11:05] Please watch that one if you haven't. It was quite insightful. So I guess this first downslope rule kind of has two halves that fit together. First, get the most work you can out of every unit of energy, and then second, put some of what you've saved into reserves or buffers because those buffers are gonna be what carry you through the inevitable higher standard deviation shortfalls that on the upslope society protected us from.

[00:11:40] The downslope rule is gonna be to build in slack and buffers deliberately and treat that slack as insurance. Okay. On the upslope, as you've all heard me say 500 or 1,000 times, a barrel of oil does four to five years of human work. So labor from human and animal muscle became almost worthless as a source of work globally.

[00:12:13] Why pay a person for a full day of physical labor when a gallon of gasoline can do it for a few dollars? So our socioeconomic rule became: replace muscle power with machine power everywhere we can, and in doing so, treat human labor as a cost we should attempt to engineer out of the system. On the downslope, as net energy access per person falls, the machines are gonna get more expensive to run, and/or there will be fewer of the machines, and/or the existing machines will be controlled and accessed by fewer of us. And because of all that, the muscle that was not worth much starts to be worth something again.

[00:13:04] Human and animal labor comes back into the economy slowly, and probably it will arrive first in the places where fuel gets scarcer and more expensive. This is not me wishing for this to happen. It's simply what's likely to happen when our energy slaves ask for significant pay raises. Okay. On the upslope, to use a golf metaphor, we had a lot of mulligans.

[00:13:38] When something broke, we could throw it out and order a new one because the energy embedded in making a new thing was so cheap that a replacement cost less than the hassle and complexity and time of hiring a repairman and all that. In our current late carbon pulse upslope era, repairing things has become mostly a hobby for MacGyver types who happen to enjoy it.

[00:14:11] But on the downslope, the energy that we've already spent on things we possess may be perhaps the most valuable thing about those things. A furnace that works, a tractor that works. These things, again from an H.T. Odum perspective, are each a pile of past embodied energy that we won't have to spend again.

[00:14:41] So the downslope rule, I suspect, is likely to flip to fixing things, maintaining them, making the upfront embodied energy spent last for a long time. And in the rich world, I expect most of the buildings that will be standing in twenty fifty are already standing. However, our current cultural incentives are still advocating and choosing new over repairing, and that applies to a lot of things, not just buildings.

[00:15:16] Okay. On the upslope, bigger was cheaper and distance between production and consumption was almost free. It has cost so little energy to move a container across an ocean that a single ginormous factory on the far side of the world can ship its products everywhere at a fraction of that product's total cost, which is how things like a tomato from three thousand miles away end up somehow being cheaper than the one from your neighboring county.

[00:15:55] And these globalized economies of scale and resulting six-continent supply chains, they only work while the cost of energy to move them is tiny. And on the downslope, this will likely stop being the case. And as a general rule, every mile between where something is made and where it's eventually used becomes not only a cost, but also a vulnerability, especially for essential goods.

[00:16:30] So the downslope rule: closer will mean cheaper and will also mean safer. What's unfolding now in Hormuz is a preview. Okay. In ancestral times, humans used to be generalists, Jacks and Jills of all trades. And on the hydrocarbon upslope, this energy surplus allowed for specialization in our society to be rewarded.

[00:17:06] You could do one narrow task for the economic superorganism extremely well, and then use your surplus, AKA salary, to buy everything else because the system around you was super complex and reliable. So competence became something we could buy, and probably for the first time in history, a human being could go through an entire life without knowing how to grow food or stay warm without electricity.

[00:17:40] And this human superpower basically costs us nothing. On the downslope, this cornucopia system that we still partake in is gonna get less reliable, and the gap between what we're able to do ourselves and what we're gonna have to depend on strangers to do is gonna increasingly become a bigger risk. So I expect households and communities that can do many things reasonably well will outlast the ones that hyper-specialize in one or two things, and their plan is to buy the rest.

[00:18:21] And you don't have to become a full-time farmer for this downslope rule to become true. Okay. On the upslope, debt was a brilliant social technology, and it worked because for a long time, tomorrow really did have more energy and stuff than today. So it made sense to borrow from a bigger future to build something today and then pay it back out of the resulting growth stream.

[00:18:56] Mortgages, pensions, sovereign bonds, the whole financial system are a bet that the future will be larger than the present. And since nearly all of our money is created as debt in the first place, brought into being when a bank makes a loan or a government spends, our money itself is kind of the same bet.

[00:19:23] For almost two centuries, this bet kept paying off, but if you're following the news, we're already seeing the early signs of a phase shift here. On the downslope, the future will generally have less net energy than the present.

[00:19:43] And whether that happens or not, the perception of that happening is also important. So a claim on the future is gonna be a claim on something that's shrinking in aggregate. So debt that assumes growth cannot be made whole in real terms, whatever the nominal numbers before inflation tell us.

[00:20:11] So I think the downslope rule flips from "let's leverage the future" to "we have to steward the present, live off current flow, and try to make sure that we keep our principal intact." What does that mean in practice? Not carrying debt that only works out if your income keeps growing. Keeping what you save and putting it in things that hold their value when money doesn't, like land and tools and friends and soil and MacGyver skills.

[00:20:47] Culturally, I would expect what nearly every pre-carbon pulse society believed in to eventually return, and that is that lending with interest is a sus practice because interest only makes sense when tomorrow is reliably bigger than today, which historically has not been the case, and that unpayable debts invariably get defaulted on, written off, or forgiven, jubilee in the Bible.

[00:21:20] And who absorbs such losses is the next downslope rule. On the upslope, a rising tide of growth lifted most boats, and in doing so, and we don't think about this, it did the hardest work of politics for us. 'Cause when the pie is growing, no politician has to decide who gets which slice because everyone's slice over time gets bigger, and the fights over the pie, literal and metaphorical, stayed small.

[00:21:58] A rising tide lifting all boats is an upslope rule, and it allowed a century plus of politics to be more about the growth rates and policies instead of fairness

and distribution. On the downslope, by definition, the pie will stop growing, as will eventually the perception of the pie as an inevitably growing giant peach pie.

[00:22:33] And I was thinking of James and the Giant Peach, kind of a mixed metaphor, but you get the picture. Who gets what is gonna become a central political question going forward. And I think the evidence is quite clear that historically, societies that shared the pain in a way that people believed was fair and reasonable, they held together through contraction.

[00:22:59] And societies where the top kept its slices of pie while everyone else's portions shrank, those societies came apart. Joseph Tainter's work on collapse, Peter Turchin's work on elite overproduction both kind of point in that direction. So fairness is likely to stop being some nice slogan and suddenly become a metric on whether a country remains a country, to be honest.

[00:23:32] And the handful of players that have outsized reach, like the biggest corporations, the biggest wealth holders, the nation states, we could call this demographic the hyper agents. They're likely to resist this downslope rule change the longest because it's aimed at them. Okay, this could be a much longer list, but last but not least, and this is to me the most interesting insight I had when reflecting on this, this week, so treat this as a draft, 'cause I'm still thinking about the implications.

[00:24:18] On the upslope, we built machines that read nearly everything humans have ever written and learned using enormous amounts of data and energy to predict things, what comes next in the sentence and such. But can you guess where I'm going? Almost all of that writing came from the last and greatest century of the carbon pulse by people living fully inside this massive surplus.

[00:24:55] So what these large language models absorbed is the upslope rule book in concentrated form. You ask an AI how to run a business or a farm or a

nation, and the answers are likely to involve things like efficiency and scale and speed and growth because that's what's worked in the world that comprised their training data.

[00:25:27] Now, the downslope knowledge is in there, H.T. Odum and Georgescu-Roegen and Limits to Growth and lots more of that stuff, but it's esoteric and it's buried under a billion pages that assumed more was coming as a general rule, and AI is a consensus machine. So essentially, people asking AI about the future today are getting unbelievably biased answers because the library they're drawing from was written entirely on the upslope.

[00:26:01] And on the downslope, updating that library would take a centralized, somehow, mountain of energy. So I think either the models will stay frozen in that world that made them, or also possible, they're gonna get retrained by and for the few who can afford them. And under this pathway, the knowledge that's gonna matter on the way down, things like which seeds will work in the valley I live in, or how do I keep that old pump running, or who in my town knows how to fix this?

[00:26:47] Those things are all gonna be local and spoken human to human, and probably not even written down. And so there's no corpus of data that could ever hold it that way. So part of the downslope rule here is: the human who knows things, rather than the human who can search, will start to matter again.

[00:27:14] And even though large language model technology will understand the implications of peak net energy, it will still be incentivized and programmed to please or acquiesce to the human that's using it and continue to sycophantically spout the same upslope-dominated references. I'm not entirely opposed to AI.

[00:27:39] I just know the hierarchy that it falls in, and I don't see good pathways at present. But I can imagine a useful version of this technology on the downslope. But it would be small and local and run off some solar panels when

the grid is down, and it's consulted for competence more than growth and attachment.

[00:28:06] So the bias of AI to upslope rules is really an entire Frankly on its own, and I'm still thinking about it. Would love your thoughts. So in making this list, preliminarily, on the downslope rules of the carbon pulse, I realize that what I've done here today is probably just scratch the surface.

[00:28:33] So I think what I'm gonna do is follow this with a part two on human and cultural rules, as today's was mostly about energy and technology. Human and cultural rules like extended childhood enabled by the carbon pulse, and extended retirement and such. And maybe even a part three on ecological rules, which we probably don't have much say in.

[00:29:03] So as viewers of this channel, I'd be curious what type of rule changes you envision as society moves from the upslope to the downslope of the carbon pulse. Have a good weekend. I will talk to you soon.