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Conclusion

Physics equates energy with work, a mechanical calculus. The thermodynamics of energy is only the first tier of understanding how modern ecology relies on a series of tricky conversions between fuel and its outlets: work, heat, light, and food (fuel reborn) (Johnson 176). Consider a basic energy-based distinction between two farmers. The mindset of the plowman and his oxen, fueled by biomass, are quite different from the mindset of the farmer atop a massive diesel tractor, even though the final aim, a plowed field, is the same. In relative quiet, the plowman directs and cooperates with his animals, perceiving their moods and health, and observing minutely the turned soil that passes beneath his feet. The soil has tangible, aural, olfactory, gustatory, and visible qualities that he recognizes. His work behind the animals has its own dungy redolence. He may sing a work song to keep the cadence regular and the mood high. His attention is fully dedicated to the unmediated, unsheltered conditions of work, so the vernal shower and the spanning sun inform his thoughts. Growing fatigue does, as well, and perhaps concerns about bad harvests spurred by the memory of them. Patience with himself, the oxen, the plow, and the soil are required, and the talent of patience may assist his higher meditations over ten hours of labor. The scale of his work is confined by the endurance of muscles; a furlong is the standard distance that an ox could plow without resting—about one-eighth of a mile—before turning back to plow the next furrow. An acre is the area one man and one ox could plow in one day—one furlong by one chain (twenty-two yards). Area is defined by energy output/time: the acre converts biomass energy into geography.

As a rough comparison of energy and effort, modern tractors can exceed 350 horsepower and plow a favorable acre in five minutes—about 1/120th of the time it took our traditional plowman. The farmer driving a tractor, citizen of the industrial era, may share some thoughts on soil fertility or physical fatigue with the plowman, but kinship between them is limited. Wendell Berry has argued

that conventional farming is closer to mining (the wealth of the soil) than it is to traditional muscle-driven organic agriculture (Nye 193). The machine driver dwells in a space of mechanical noise and fumes, vibrations and jolts, and perhaps even air conditioning and satellite radio. He sits two yards above the soil and rarely touches it. He thinks of space and limits of work in the terms of the fuel tank, and he probably thinks of fertility in terms of petrochemical additives, also deployed by a rumbling machine. He does the work of dozens of plowmen, freeing the (greatly increased) population to work not as farmers cultivating biomass, but as operatives in the numberless tasks of industrial production and consumption that keep us busy in an economy that requires us to work for food, but not to work to produce food.

The modern industrial farmer is more a mechanic and soil chemist dealing in fossil fuels than he is a husbandman and cultivator orchestrating biomass. It's not at all surprising that humans have embraced this much faster method that fobs off hard work onto machines and fossil fuels, nor that we interpret this shift as a kind of natural progressive evolution of human culture. The poignancy comes with what we've lost for the gains, losses that receive very little attention in a mainstream culture designed to value monetary profit under the economic mantra of limitless growth—a kind of anti-ecology.

A suburbanite can observe this distinction between muscular and fossil fuel energy by clearing leaves from her lawn. If she chooses the old-fashioned rake, the work will involve steady physical work, the rustle of leaves and twitter of animals, and the smell of damp leaves in gentle decay. It may take up her entire afternoon, and she may have a sore back afterward. If she chooses the modern leaf blower, the work will be less physical, quicker, deafening, dusty, and fummy. The former involves immersion in the task at hand and perhaps considerable sensory pleasure along with slight discomfort; the latter implies impatience, sensory disharmony, and hastens to finish because the task is noisome.

The end is the same, but the means could not be more different. We usually choose the leaf blower because we wish to avoid physical work, which has come to appear laborious—unworthy of our time when there are so many other attractions. The blower is more “efficient”—in the ideology of time as money—though by calorie count it is much less so. The same contrast of biomass and fossil-driven work can be found inside the home with the broom versus the vacuum, the mortar and pestle versus the electric grinder, the knife and board versus the food processor. These choices—we make them constantly, whether to walk or drive, whether to grow a garden or take a summer trip to Europe, whether to patronize the farmer's market or the Megamart—are all ethical,

ideological, and ecological choices. They add up to our existence, how we chose to dwell on earth. They may all be reduced down to fuel, or built up to our experience of what life is. There is nothing inevitable or predetermined in the ways cultures select and deploy energy; there are only options and choices, which in retrospect are sometimes confused as destinies. History is filled with charismatic personalities who appeal to the masses with their optimism, and the history of fuel shows how industrial optimists from the railway's George Stevenson to the automobile's Henry Ford touted the advantages of fossil fuel and its reliant technologies without accounting for its problems. Problems are more difficult to forecast than profits.

The preindustrial world was constantly pressed against the limits of biomass and worked to conserve its energy to maintain sustainability. Feasts and bacchanalias represented the seasonal joy of achieving a margin over the energy line, permitting the effusion to feast and imbibe as an exception to low-energy life as usual. (A major exception to the stricture of conservation came with the first waves of settlement on formerly wild lands, especially in North America where vast forests were cleared and burned to make way for farms and pasture.) The industrial world, on the other hand, is designed to consume energy, not just to sustain life, but in any way that is in the short term economically profitable or just dumb fun. Fossil fuels are wonderfully indulgent of our evolutionary instincts to secure calories, modify climate to comfort, and powerfully and rapidly move our bodies through space. They give us the illusion of being gods. This illusion is so potent that we struggle to conceive of a world without them, of what we would be without them. Coal and oil are now as much a part of our nature, our ontology, as the sowing and the harvest; many would argue that fossil fuels have fully eclipsed the essential rituals that permitted human survival for thousands of preindustrial years (botanical, animal, and seasonal knowledge, access to clean water, physical self-defense). The Industrial Revolution imposed the most rapid and comprehensive social evolution in the history of our species, alienating our understanding of the lives of our ancestors just three or four generations ago.

Solitary, poor, nasty, brutish, and short. There were many essential downsides to low-energy biomass life, whether of the itinerant hunter-gatherer or settled agrarian kind. Arable land was strictly limited, conditions were variable, and populations continually exerted upward pressure against the bubble. Average bodily comfort in terms of safe food, drink, and pleasant temperature was much lower. Disease and famine lurked continually. Work was usually physically demanding, repetitive, and exposed. It was more often dangerous. Margins

were closer because the energy line fell lower on the graph, just skirting above the survival line. Self-generated hay, wood, meat, and grain don't lend much breathing room. In a biomass world in an average year, the buffer from going hungry in late winter was usually thin: several thousand calories of leftover grain, potatoes and preserves in the pantry, lumps of hay converted to meat and eggs. The perennial struggle to survive on Greenland culminated each late winter when the Norse would "pray that the stores of dairy products and dried meat for human food, the hay for animal fodder, and the fuel for heating and cooking didn't run out before the winter's end" (Diamond 231). Jared Diamond's analysis of cultures that fail to subsist has a leitmotif of biomass collapse, lost forests and topsoils especially, which catapulted marginal societies off the land in places as diverse (and isolated) as Easter Island, Ancient Maya, and Norse Greenland. Even in times of peace, among societies well-established in farming and trade, life on biomass involved relentless work, careful provisioning, and inevitable privation.

Now, in any season, the average fossil-fueled individual has billions of calories at her disposal from numerous competing retail outlets, if she has money to exchange. Fossil fuels buoy our high-flying energy line well above survival line, so far above survival that most people in developed nations have never experienced anything life-threatening, except the situations fossil fuels put us in, like a car at highway speed. Where hunger exists, it can be accounted to failures of social protection rather than a lack of available calories. Hardly a vanishing fraction of present-day humans in developed nations would choose to switch their lives with those of ancestors in preindustrial times—the vast majority would remain in the world of Dunkin Donuts and immunization. The ontological losses and the environmental impacts of a fossil-fuel world, issues of philosophy and ecology, measure poorly against its evident comforts enjoyed along every inch of the body. Materialistic ennui cannot compete with deep physical hunger on the scale of suffering. So, as literature tends to idealize the old ways, it is important to remember the variety of harrowing implications of living without gassed-up engines.

Fossil-fuel-driven capitalism satisfies our inherent desires to make ourselves physically comfortable and well-fed and to compete in life's races, large and small, and feel that we have won. From the green light drag race against the stranger next to you, a battle that rationalizes driving a car that gets eighteen miles per gallon, to the lofty 401(k) balance at retirement, we define ourselves materialistically. This label of success reflects number (net worth) as much as number of possessions, and the president and the television and the neighbor

and each of us to ourselves ascribes self-value to material success. There's a mountain of self-worth on sale at the Big Box. That's the upside of fossil fuelology. The downside is that in order to afford our ticket, we must work within the cash nexus, usually several degrees of separation from the agriculture that sustains our life. In the organic economy, all work was a first- or second-degree relation to food generating. Work in the modern world has become sedentary, bureaucratic, anonymous, and often trivial in outcome. It dissolves self-identity into corporate conformity. It leaves our human nature wanting physical work, even if our specific bodies have forgotten what that is, or interprets work as a half hour on a coal-plugged treadmill. We are replaceable, expendable, and the result of our work is simply to keep the machine in motion: the factory line, the checkout line, the customer service hotline, the drive-thru lane, the paper trail, the tenure track.

In a biomass world, work was intimately tied with survival. It is one step between an old-time farmer's actions and his supper plate; two steps between for the shopkeeper in town. Work was easy to explain: "I make barrels." Rather than a compulsory exchange of money, goods and skills were traded readily in a barter economy, giving each skilled member of a community a sense of belonging and purpose. At its best, artisanal work in small communities required personal relationships of trust within collaboration, and working interests often translated into civic ones, with prominent skilled craftsmen often doubling as politicians, negotiators, and religious leaders (Nye 54). The limits of energy forced communities into synergetic cohesion and the sharing of wealth, as well as privation. At its best, the preindustrial model is at least as good for quality of life, and perhaps better than the welfare state of a modern social democracy.

In the high-energy information age, job descriptions come in dense paragraphs of special language, and their relation to the basic purposes of life to feed yourself, to feel love and safety, and probably to procreate exists solely in the paycheck that itself no longer has material form. Numbers on a website on a computer screen turn into bread and wine. What alchemy! Your work has nothing to do with producing food or building shelter or preparing for winter. Your paycheck delegates all that to outside channels: dairy farmer, contractor, HVAC guy. So, fossil fuelology has at its heart an irony: it gives us everything evolution has taught us to desire while depriving us of the nature-navigating work we spent long, formative millennia doing in order to survive. We get the stuff without making it. We survive without owning ourselves. Kraft and Cadillac own us, fill us, move us. Disengaging from fossil-fuel culture involves retraining

the body to operate without the superhuman infrastructures those fuels have provided, from the excessive speed of the car to the superfluous cool of the air conditioner. This “decoupling” of body from memory is a central challenge of adaptation into the twenty-first century (LeMenager *Living Oil* 104).

Generally, we have acquiesced to the costs to mind, body, society, and nature that fossil fuels have exacted in exchange for the luxuriance of energy. Retrospect often recalibrates the cost-benefit analysis in a more balanced way than contemporary perspectives possibly can. Retrospect often gives more credit to costs, liberated from present concerns of rapid development and continual growth in economies. The steam engine’s benefits helped dispel the manifold problems with pollution, disastrous accidents, and social oppression. Another beneficiary of present-tense optimism was the automobile, which initially transformed the American landscape toward access and convenience, but ironically has left a legacy of inaccessibility and inconvenience that we mean to redress with walkable community retrofitting. Nuclear energy optimism has rationalized its costs, too, of pollution and contamination, and perhaps the steepest disaster-to-benefit ratio energy technology has ever seen. A steam engine can blow up and kill a hundred workers, but a meltdown seeps beyond the serious events at Chernobyl and Fukushima to saturate an apocalyptic imaginary on a global scale.

Any “renewable” must be given the necessary time and space to renew itself, and many biomass sources—wood, whale oil, and peat—are fuel sources that have been harvested unsustainably. The exhaustion of one natural resource inevitably excites economic development of the next available energy platform: fossil fuels. Fossil fuels are more densely energetic than biomass, so the great industrial conversion of the last three hundred years represents a “step-up” platform, especially when fossil fuels were relatively easy to mine and drill. Now that is no longer the case. Our next energy platform will likely be some combination of new renewable, new biomass, and nuclear: a portfolio of dispersed, sporadic, and occasionally dangerous sources. Besides, they are not likely to provide as much energy as that provided by coal, natural gas, and oil. From an energy perspective, any step away from fossil fuels is a step down.

Consuming fossil fuels is the very definition of unsustainable. For the last two hundred years, straight through the present and for some unknowable extent into the future, we are defining a radical blip of high-energy frenzy that is the exception in human history. It cannot endure in its present form much more than a few generations, considering limits set upon supply and the climate change that may shake industrial consumerism at its foundations. So,

to some extent, past is prologue: renewable biomass will return to the human scene, complementing the contributions of high-tech new renewables from the sun, winds, and tides. This inevitable change, both paradigm shift and paradigm slip, will probably not transform us to itinerant bands of hunters or peasant laborers working scraps of land. Apocalyptic fiction plays with such notions, but the future truth is likely less sensational. Imre Szeman comments: “What we desperately need in our literary present [is] . . . narratives that shake us out of our faith in surplus . . . not by indulging in the pleasures of end times but by tracing the brutal consequences of a future of slow decline, of less energy for most and no energy for some—a future that might well have less literature and so fewer resources for managing the consequences of our current fictions” (326).

Communities need redesigning. Neighbors need introduction, and individual possessions open to community networks of sharing. Food needs more local sources of production, and higher rates of participation. The world will shrink back toward the scale of muscles, except the internet exchanges that may continue to unify the globe. To a limited extent, the internet allows us to have it both ways: global information, local production and consumption. The best way to avoid tumbling off a cliff is to scale down one careful step at a time. The optimistic tail of the Anthropocene arc envisions human culture proactively changing from fossil sources to renewable ones, and adapting to climate change through active innovation in agriculture and stewardship.

The energy humanities show how labor translates most obviously into energy, but more subtly into myriad movements of history, cultural and ethnic identity, and ecology. For example, music theories suggest that modern jazz music evolved to help attune urban populations with the tempo of electricity, rapid transport networks, and bustling production; the nervous, aimless, improvised jazz brought exosomatic conditions into the body’s rhythms (Johnson 73). Literature has enough complexity and depth to enlighten readers on many levels at once—from emotion to history to genre to energy—without collapsing into simplistic admonition and prescription. In this book, the background energy has been brought to foreground, but the characters and their dramas endure, enriched further by the context of their fuel regime. Literature records the historical continuum from annually renewable fuel toward nonrenewable fuel in our recent history, and it preserves the lives and landscapes that have evolved along this historical arc.

William Blake proclaimed that “energy is eternal delight.” Seeking to recover the body’s pleasures from a censorious Anglican church, Blake’s marriage

between heaven and hell embraces the diabolical energies of sex, revolution, and individual faith. These higher-order functions result from the simple, intimate act of eating to sustain the body, which is our interface between the soul and the mysterious material/spiritual world that Blake and the Romantics explored. Energy is fungible, transforming from food to agency in the world, and Blake saw that energetic devils were better vessels to embody his ethos of revolt than were prurient angels preening over dead texts. The devils feel both despair and delight, joy and its partner, melancholy. Amid the Industrial Revolution, Walter Pater asked his readers an ontological question: "How shall we pass most swiftly from point to point, and be present always at the focus where the greatest number of vital forces unite in their purest energy?" (197). His answer comes in the very next sentence: "To burn always with this hard, gemlike flame, to maintain this ecstasy, is success in life. In a sense it might even be said that our failure is to form habits: for, after all, habit is relative to a stereotyped world, and meantime it is only the roughness of the eye that makes any two persons, things, situations, seem alike" (197). We might toss this aside as a young man's philosophy, or a young society's, impossible to maintain through the drudgery and repetition of our thirty thousand days on the planet. But in the end it is a matter of spirit and attitude, not age.

At both individual and collective levels, we can cultivate a hard gemlike flame of infatuation with the variety of life if we train our minds to it. Better yet, no high-energy fuels are needed to keep the flame lit. In fact, these fuels, by doing work in the world that we have evolved to do ourselves, often tend to dull the edges, blur the distinctions, and abridge the richness of experience available to the susceptible person. We have worn into a deep groove of high-energy self-absorbed ideology that seems deterministic, but the elements of another, subtler, more ecstatic world have always roiled in the background. By sidelining the fossil-driven ego, we may pour over the beauty of the forms around us, which capture today's energy within the coil of life. The aesthetic of life, made of photosynthesis, hydraulic cycles, and trade winds, beckons stronger than the cadaver soup of the primordial fossil. It is a hazard, to humans and the planet, to lack the imagination that envisions the many ways in which the future might be cultivated. Our lifetimes in this twenty-first-century Anthropocene provide the opportunity to craft a future that brings the best out of fuel.

And for those who love the machismo of a Cadillac shredding the American West, there is a promising future in extreme speed. The Tesla Hyperloop has tested at more than two hundred miles per hour; Maglev trains in Japan have

carried passengers at more than three hundred (“Japan”). The twenty-seven-mile test track near Fuefuki harkens back to the Stockton and Darlington line in 1830s England, where Fanny Kemble was wonderstruck at thirty-five miles per hour under a trail of smoke and steam. But tomorrow’s hyper-speed normal will use linear induction motors, which can run on the sun.