

For $\text{\textcircled{E}}$ growth

A growth that tends to produce more energy-matter¹ than it consumes

RICHARD LOIRET

A good government must be based, as Physiocracy emphasized in its time, on the recognized utility, managed as such, of the humus (an energy-matter complex) accumulated in fertile soils, the true engine of the economic machine. But, as Marx will observe, throughout the industrial revolution, the liberal classes would instead engage in the "plunder" of this humus, the secret of their primitive capital accumulation. And their unquenchable thirst continues to this day, through the ever-increasing extraction of new, ever more productive energies, drawn more widely and deeply from the Earth (fossil fuels, ...), in ever greater quantities, to power ever more machines². But the corollary was inevitable: the more these energy stocks transformed into capital, the more the carbon it contains dissipates into CO₂, giving us this curious and all too real "chemiconomic" equation: Carbon = Capital + CO₂

Of course, we would be tempted to simply reverse the terms of the equation³, to see the emergence of a form of economy in which we would accumulate "carbon-energy"⁴ by recycling both CO₂ and capital. This, as suggested by this model of non-punitive ecology, an Eco-tax "allocated" to CO₂ recycling⁵, which, among other virtues, financed organic agriculture. But this alternative to growth, while initiating the concept of "Carbon balance," collided head-on with the logic of the system and ignored the question of Life, which itself encounters, as we will see later, a conceptual and radical barrier.

$\text{\textcircled{E}}$ growth aims to address this question. This term, because its prefix "œ" refers us to *œconomia*, the

Greek economy of the *ecumene* (*οἰκουμένη*)⁶, from a time when the City was not separated from the *Oikos* by a radical political barrier, which transformed it into *chrematistics*, the monetary economy at the origin of capitalism. In French, the two short words, "œuf" and "œil" (egg and eye) stem from it, not to mention "œuvre" (work), and potentially "cœur" (heart). So this prefix also refers to the notions of organic sphere, gestation, inner growth, and the full expression of life. It is finally found in the French term "*œcuménisme*", (*ecumenism*) which directs us toward a common action engaged by various currents of thought, despite their doctrinal differences. Furthermore, as it is pronounced "eu", this prefix is also full of promises. It comes from the Greek "εὖ" which means good, well, true, and is represented by the letter "ø" (*phi*, the golden ratio). In common language, we have *eukaryote* (true nucleus), *euphony* (related to harmony), *eutrophy* (good nutrition), *euphoria* (of the well-being), etc., although *eugenics*, which aims to improve human existence, may lend itself to interpretations. Thus, this term can be written indifferently as " $\text{\textcircled{E}}$ growth" or "Eugrowth" ⁷.

Simply defined, and for any territory of determined perimeter where there exists a comparable relationship between the production and consumption of carbon-energy (from family property to national economy until the entire Earth), $\text{\textcircled{E}}$ growth results from a joint Human-Nature work whose net yield (production minus consumption) under the "Ecological Balance"⁸ of this territory (*Ecological Assets* minus *Ecological Liabilities*), tends to become greater than 0.

Conceived in this way, this principle was long applied, at least intuitively, in the local economy of ancient communities' *ecumene*, such as the cultivated forests of the Amazon (domesticated landscapes), which an increasing number of researchers are studying (William Balée, Clark L. Erickson,...). $\text{\textcircled{E}}$ growth would be increasingly applied today in territories adopting organic farming, *permaculture*, *edible forests*, etc.

However, $\text{\textcircled{E}}$ growth becomes more complex when, beginning with carbon-energy and its well-established measurement, its scope of intervention expands to the question of Life, to biodiversity and the biological processes associated with it. This then becomes what is called "*biogeochemical*" energy, which raises the question of an entropy of life that is said to be "negative", and opposite to entropy, typically understood as positive. Here, with the "ther-

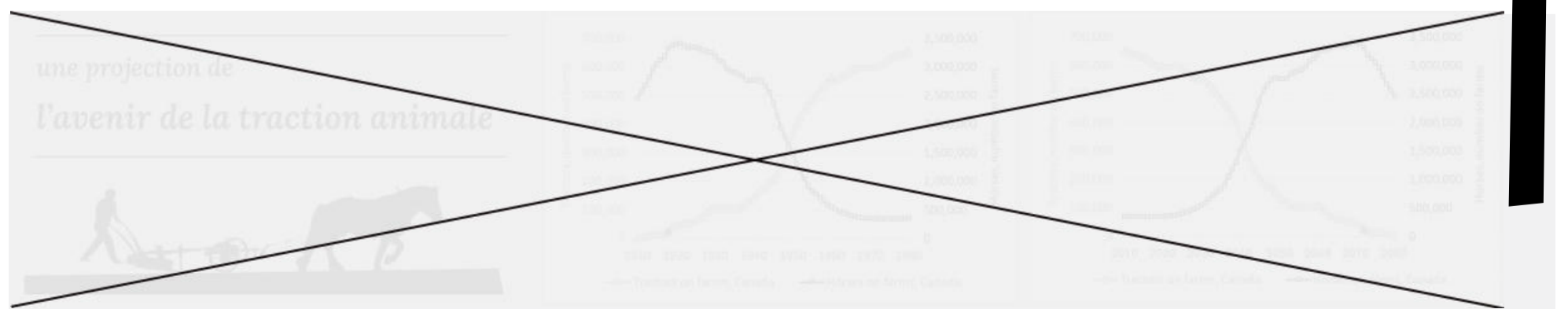
modynamic" version of the ecological balance⁹, we encounter a notion of "fertility," of ecological regeneration, far more extensive than just the recycling of CO₂. This production-consumption system, from the most local scale to the entire planet, seeks to accumulate, jointly with Nature, and through its overall metabolism, at least as much if not more negative entropy (in the form of energy-matter) than it consumes.

Nevertheless, this concept of growth faces a fundamental barrier in the history of sciences.

An "impossible" energy accumulation

Around 1880, the Ukrainian scientist *Sergeï Podolinsky's* "Theory of Energy Accumulation" drew a lot of attention with its "seminal" concept of synergies from a "joint work" of Man and Nature, and his luminous demonstration of its cumulative surplus effects, based on the translation of agricultural resources into energy (see below).

Engels and Marx greatly appreciated this theory. But more recently, it was challenged by the underlying threat of the "second principle" of thermodynamics, which Arthur Eddington universalized in his "Arrow of Time". Here, he marries Darwin's randomness with Clausius' entropy to translate the irreversibly entropic nature of evolution, adding that: "The law that entropy always increases - the second law of thermodynamics - holds, I believe, the supreme position among the laws of nature. If one discovers that any of your theories are in conflict with the second law of thermodynamics, I can offer you no hope; there is nothing for it but to collapse in deepest humiliation?" Such a powerful threat to the intelligentsia, that since then, throughout the physics of the 20th century, it has implicitly assumed that negative entropy does not exist¹⁰. For Marx and Engels, even if it was the implicit assertion that life and all its expressions did not exist, or at best, that they were meaningless and uninteresting in the grand scheme of the universe, and even if Marx had decrypted the secret of capital accumulation, it was feared that the increasing entropy of industrial metabolism would contradict Podolinsky's theory.

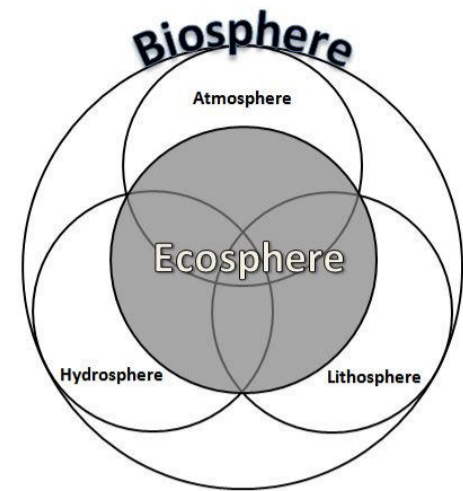


Energy accumulation and productivity of joint labor between nature, humans, and machines

Comparative evolution, between 1870 and 1970, of production and energy productivity in French agriculture	Yield Qtl/ha	kcal/ha			kcal prod. / kcal conso.	
		A - Energy production	(b) Energy surplus compared to natural grassland	(c) Energy consumption (human - animal - machine)	B - Energy productivity	
		(a) Total harvest (hay or grain + straw)			(a)/(c) Total productivity	(b)/(c) Surplus productivity
1870 Source : <i>Theory of energy accumulation, Serguei Podolinsky (1880)</i>						
1 - Natural grassland	25	6 375 000	0	0	∞	∞
2 - Traditional artificial grassland	31	7 905 000	1 530 000	37 450	211,08	40,85
3 - Traditional wheat cultivation	8	8 100 000	1 725 000	77 500	104,52	22,26
1970 Sources : <i>Leach (1973), Bel et al. (1978), CNEEMA (1979)</i>						
4 - Mechano-chemical artificial grassland	50	12 660 000	6 285 000	2 260 000	5,60	2,78
5 - Mechano-chemical wheat cultivation	50	32 750 000	26 375 000	4 000 000	8,19	6,59
6 - Mechano-biological wheat cultivation	40	26 200 000	19 825 000	1 330 000	19,70	14,91

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Commentary: In 1870, the energy production of a natural area (A1) is enhanced by human and animal labor (A2,3). It is significantly improved by 1970 with the introduction of mechano-chemical methods (A4,5,6). However, only energy productivity (production / consumption) is capable of generating energy accumulation in the biosphere. It is entirely positive for natural areas (B1), and remains very high in 1870 with human and animal labor (B2,3), at the same time that production (A2,3) increased. But by 1970, while energy production has greatly increased, mechano-chemical methods have simultaneously generated more entropy, causing energy productivity to drastically decrease (B4,5); although organic farming has marginally improved it (B6).



Which indeed proved to be the case in the 20th century (see above).

As they couldn't measure this entropy, and moreover considered that there was no bridge between use and exchange values, Engels and Marx feared collapsing, as Eddington would say, "in deepest humiliation," and rejected this theory, sending Podolinsky back to his origins. This same principle has since influenced all ideas about alternatives to growth. Examples include Nicholas Georgescu Roegen (*The Entropy Law and the Economic Process*, 1971) with "Degrowth"¹¹, as well as its radical counterpart, which could be called "Overgrowth" because it seeks to push the dissipative expression of the economy to the apex of its "cosmic" direction (Raine, Foster, and Potts, *The new entropy law and the economic process*, 2007). To the extent that Ignacy Sachs, co-designer with Maurice Strong of "Ecodevelopment," this beautiful promise from the time when they jointly led the 1972 UNCED, could be confused with "Sustainable Development," which they would later champion while directing the 1992 UNCED. This continues today with the concept of "Ecological Footprint," which has not been able to resolve this issue, as its creators have acknowledged¹².

The "Ecological Balance" initially addressed this question of entropy, drawing in particular on the work of W. Vernadsky, the father of the Biosphere (13), and further that of biodiversity and the measurement of living energy, with the crucial problem of Information Theory, which measures only positive entropy. The concept of œgrowth could therefore be envisaged; it implied an economy that would reverse both the effects of negentropic pillaging of the Biosphere and the Ecosphere (14), as well as those of the Anthroposphere. This would occur through a "biogrowth" (see note 2) that would

one day involve not only plants and animals but also human ethics and poetics.

Although its formal measurement, already complex in its understanding, would undoubtedly be even more so in its implementation, and even more so in scaling up the territorial levels of our societies, the preliminary method exists! Would the game of its implementation therefore be worth the candle?

Richard Loiret is Agronomist and Thermician, and holds a PhD. in Ecological Economics. With the participation of Paul-Emmanuel Loiret, Architect, Prof. for this article.

(1) Here, "energy-matter" bears some similarities to the mass-energy "E" of Einstein's equation ($E=MC^2$), in the sense that it relates energy to mass. However, here it is a "living" mass, illustrating the essential participation of life in the biosphere's energy accumulation function, when it transforms free energy into energy mass. Throughout its transformations, the variation in energy density (or pressure, in joules/m³) of living matter and its variation in mass density (in kg/m³) are indeed strictly correlated (See (8), Table No.7, p 195). Energy-matter thus refers, like the notion of "exergy," but in a more (thermo)dynamical way, to the energy embodied in all forms of matter produced by the action of autotrophic organisms. This includes living matter (and organisms) as well as inert matter, known as biogenic matter, directly derived from life (dead wood, humus, limestone, etc.), or indirectly (oxygen, spring water, sediments, etc.) - see (13) for more details - and as found everywhere in the biosphere "and" the ecosphere (14). Thus, the economy is nourished almost entirely by energy-matter, with a scope much broader than carbon-energy (4).

(2) From this, we can deduce that current growth (of global GDP) is nothing but "necrogrowth," or even better, "abiogrowth," as opposed to "biogrowth," because it certainly feeds on life and its energy (as living beings do), but in a system that does not regenerate it and gradually suffocates it, resulting in ever-widening destruction of the planet, beyond just climate change. Note: The concepts above in quotation marks were conceived by Paul-Emmanuel Loiret, to juxtapose financial growth of a materialistic economy with living growth.

(3) Of course, this refers to the well-known chemical equation concerning the transformation of carbon : $CH_2O + O_2 = \text{energy} + CO_2 + H_2O$

(4) Carbon energy refers to the energy contained solely within the organic carbon of wood, crops, fossil fuels, etc. It is now accurately measured in the "carbon balance sheets" proposed by the ADEME.

(5) Loiret, R., Une écotaxe "affectée" au développement durable de l'agriculture et des territoires (Un principe d'écologie non punitive), 1994. <https://hal.science/hal-04488636>

(6) Berque, A. ÉCOUMÈNE. Introduction à l'étude des milieux humains. Ed. Belin, Paris, 1987.

(7) The two novel terms, œgrowth and Eugrowth (in their French translation), along with their shared definition, have been trademarked. This is not to prevent you from freely sharing the concept, but primarily to prevent individuals with malicious intent from appropriating and/or misusing, whether knowingly or ignorantly, both their names and their associated definitions and content for their own gain or otherwise. This is a precaution we take due to frequent observations of such occurrences.

(8) Loiret, R., Le Bilan écologique. 2016 (NNT : 2016SACL001) <https://hal.science/tel-01306180>, Doctoral thesis in which all concepts related to œgrowth are extensively studied and explained.

(9) In its thermodynamic version, this balance (8) provides us with the Distance to Equilibrium (negentropy minus entropy) of life, which specialists will note that it represents the other possible facet of Clausius balance when, in his 1865 article ("Sur diverses formes facilement applicables qu'on peut donner aux équations fondamentales de la théorie mécanique de la chaleur"), he deduced, in the pure logic of the dominant paradigm of the time, that the entropy (positive) of the universe tends towards a maximum.

(10) This was as big a mistake as Einstein's when, introducing the cosmological constant into his equations of general relativity, he "neglected" a remark in 1918 by Erwin Schrödinger, who considered that this constant implied the existence of negative pressure contrary to gravity, and that therefore an "additional component" had to be added to the content of the universe. Einstein had missed the expansion of the universe (Françoise Combes, Collège de France, La constante cosmologique : la plus grande erreur d'Einstein). Schrödinger later added another layer to this remark in *What is Life?*, where he extensively discusses negentropy, this "component" of the universe, and at least of Earth, which was "neglected" by Arthur Eddington. Moreover, would this component, seen from a different angle, be of the same nature as the first?

(11) Georgescu-Roegen, N. La décroissance. Entropie-Écologie-Économie. 1979. Electronic edition.

(12) Wackernagel, M. Thesis. Ecological Footprint and Appropriated Carrying Capacity: A tool for planning toward sustainability. The University of British Columbia, 1994.

(13) Loiret, R., La Biosphère selon Vernadsky. Contradiction du principe de Carnot. 2012: <https://hal.science/hal-00911684>

(14) While the concepts of Biosphere and Ecosphere are often confused, their semantic distinction (see (13)), which notably distinguishes carbon energy from the energy of life, proves fundamental for the proper functional understanding of planetary ecology.