



Energy, work and value. Energetics perspectives to frame capitalism and ecological crisis

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Abstract

In this paper I try to suggest that global economic crisis and ecological crisis are strictly interdependent and this interdependence is based on energy and raw materials shortage. The basic idea is that the decreasing natural fertility of capital is the cause of the decreasing global rate of profit of global capital, as suggested by Marx. Many scholars using different methods of assessment certify this current trend. Due to these global and entangled phenomena, I suggest to read in different ways the relationships between energy, labour and value. More energy for less living labour is leading to a profound crisis of capitalism/nature dialectic. A renewed materialist vision of capitalist global dynamics is needed to understand the accelerating feedback between capital and ecological crisis. The triggering aspect is the ratio between energy and labour, and the production of value, whereas a shortage of material absorbers of living, valorizing, and abstract labour have radical consequences on the generation of value, and profit. The paper tries also to show that an energetics interpretation of abstract labour is not contrasting its socio-historical organization aimed at the value generation. In this direction, I finally suggest also that labour is both a trans-historical tool for the management of the metabolic exchange of between society and nature and a generator and conservator of value under capitalist condition of production and exchange.

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¹ *manca affiliazione*

Energia, lavoro e valore. Prospettive energetiche per connettere capitalismo e crisi ecologica.

*In questo articolo provo ad argomentare che le crisi economica ed ecologica globali sono strettamente interdipendenti e che questa interdipendenza si basa sulla scarsità di energia e materie prime. L'idea di fondo è che, come suggerito da Marx, la diminuzione della naturale fertilità del capitale sia la causa della globale diminuzione del saggio di profitto del capitale globale. Molti studiosi, che utilizzano diversi metodi di valutazione, certificano questa tendenza in atto. A causa di questi fenomeni globali e interconnessi, propugno di leggere in maniera differenziata le relazioni tra energia, lavoro e valore. Più energia per meno lavoro vivo sta portando ad una profonda crisi della dialettica capitalismo/natura. È necessaria una rinnovata visione materialistica delle dinamiche globali del capitale per comprendere l'accelerazione del feedback tra capitale e crisi ecologica. L'aspetto scatenante è il rapporto tra energia e lavoro, e la conseguente produzione di valore, **mentre la carenza di assorbitori materiali di vita, valore e lavoro astratto** hanno conseguenze profonde sulla generazione di valore e profitto. L'articolo prova a anche a mostrare come un'interpretazione in termini di energia del lavoro astratto non contrasta la sua organizzazione storico-sociale finalizzata alla generazione di valore. In questo senso, propongo infine che il lavoro debba essere considerato uno strumento transtorico per la gestione dello scambio metabolico tra società e natura e un generatore e un conservatore di valore sotto la condizione capitalista di produzione e scambio.*

Parole chiave: *xxxxxx*

■ Introduction

Energy is free and available forever. In material terms, energy is the resource of resources, the master resource. Everything in the universe may be described in terms of energy. Galaxies, stars, molecules, and atoms may be regarded as organizations of energy. Living organisms may be looked upon as engines, which operate by means of energy derived directly or indirectly from the sun. Energy transforms mineral and natural resources from their raw form into consumable goods. Energy is expended to create more energy and to refine energy into more usable forms. The civilizations, or cultures of humankind, also, may be regarded as a form or organization of energy (White, 1943). In short, the way societies are 'energized' is crucial for understanding how they work, how they are "powered" (Urry, 2013).

Our "living together" is profoundly rooted and organized around large

concentrations of energy and raw materials that support and absorb growing volumes of activities. Capitalism depends on energy for the purposes of surplus-value creation, profit maximisation and capital accumulation. However, this material and energy regime seems to be completely unsustainable and increasingly untenable. The horizon that emerges because of the ecological crisis caused mainly by the fossil energy use - climate change, nitrogen cycle alteration, biodiversity reduction, peak of fossil energy, peak of raw materials - presents crucial and problematic elements for both earth system dynamics and world-ecology complex reproduction, and the global capitalist accumulation. These two complications, these two dynamics are strongly intertwined even if many refuse such a “catastrophic” vision.

The most critical aspect of such dynamics is the availability of fossil energy and raw materials needed to activate the production process and thus absorbing living labour, generating value and keeping alive the capital’s accumulation machine. A second critical aspect is the inevitability of giving up fossil fuels, because of global warming. An energetic reconsideration of the dynamics of capitalism highlights how the relationship between capitalism and energy has gradually become more complex and interdependent, and how energy has been at the centre of the global expansion of capitalism. The availability of diversified and intensive fossil energy sources lie at the base of the world capital expansion and the particularly energetic society that it has been able to generate. Capitalism has transformed generic external and environmental conditions of its own birth in an internal condition of his own reproducibility and expansion. While remaining a non-human element, fossil energy irreversibly became an internal condition of capitalist accumulation (Altvater, 2006a; Malm, 2016), but in doing so also the foundational condition of human reproduction.

The intention of this paper is to connect energy, work, and value. This might be seen as an apparently banal effort since natural scientists have already developed huge amounts of reflections considering energy as motion, force, heat, light, matter, mechanical work, and so on. However, I think that it is possible to go beyond it, looking at the social organization of energy, at its use under capitalist conditions of production, at its transformation in abstract labour and value. In this sense, this is not a trivial effort. My effort is to challenge conventional sociological approaches that have imperceptibly and progressively decided that the problem of energy falls out of their boundaries, that social phenomena such as religions, ideologies, cultures, organizations, institutions can be investigated detached from their material context, or even that those are irreducible to any material aspects. Consequently, material concretions, such as coal, gas or oil, seem to have no influence on the social. This separation between idea and matter, between abstract and concrete, is possible only in the presence of abundant and cheap energy sources, condition that it is no longer taken for granted. As Max Weber said, “For when asceticism was carried out of monastic cells into everyday life, and

began to dominate worldly morality, it did its part in building the tremendous cosmos of the modern economic order. This order is now bound to the technical and economic conditions of machine production which to-day determine the lives of all the individuals who are born into this mechanism, not only those directly concerned with economic acquisition, with irresistible force. Perhaps it will so determine them until the last ton of fossilized coal is burnt” (Weber, 2001, p. 123). In this view, also the expansion of asceticism depended on the energy availability.

I try to articulate the relationships between energy, work, and value, focusing on some aspects of Marx’s work that have not been quite dug by most Marxist literature, more concentrated on the metaphorical or non-material aspects of Marx’s texts. This is not a new reading of Marx, neither a marxologist perspective. It is only an attempt to use some insightful thoughts of Marx to throw light on some critical connections between the ongoing global capitalism dynamics and the world-ecology crisis, as many have already done. (Mirowski, 1989; Rabinbach, 1990; Caffentzis, 2013; Odum and Scienecman, 2005; Foster, 1999, 2000; Foster and Holleman, 2014; Foster and Burkett, 2008; Burkett, 2004, 2006; Altvater, 2006a, 2006b; Moore, 2015, 2017; Wendling, 2009; Hornborg, 2014, 2016a, 2016b; Malm, 2016; Chellan, 2016; Henderson, 2013). Marx’s opus is receiving an attention that increases day by day with force and clarity. Marx’s analysis of constant capital, raw and auxiliary materials, dead labour, abstract labour, value preservation, organic composition of capital, commodity, and capital flows can shed new light on the ecological crisis as not just an alteration of some parameters of reproduction of ecosystems, or an excessive consumption of raw materials’ stocks. In this light, as already suggested by many, the ecological crisis can be seen as an intrinsic limit to the process of expanded capital reproduction, the core crisis of the global capital accumulation.

In this paper, I articulate a reflection that moves around the concepts and the material dynamics of energy, work, and value. Energy here is investigated in the following aspects: in the first paragraph, I introduce briefly the concept of natural fertility of capital as it has been suggested by Marx because its variability can get radical effect on global economic process of capital accumulation and reproduction. In the second paragraph I comment the energy material/immaterial dilemma showing that at the end human beings experience energy only as a consequence on their practical activity, as a useful tool to make stuff. In the third one, I develop alongside other authors an “energeticist” vision of abstract labour as it might be seen in Marx’s texts. In the fourth paragraph, I observe as energy can be understood as a social relation providing the matrix for social activities but also for the abstractization of the labour itself. In the fifth paragraph, I comment the emergence of abstract labour as a process that happens in the context of socially organized energy. In the sixth one, I suggest that the dead labour of nature (fossil fuels) is fundamental to absorb labour energy expenditures thus generating value.

In the seventh and last paragraph, I argue that social organized labour is at the same time the tool for the metabolic exchange between society and nature and the tool for the generation of value: these two characteristics are inseparable.

■ Decreasing natural fertility of capital

Recent economic crises and financial instability not only undermine the least inertial social order typical of capitalist societies, but are also fuelled by growing socio-ecological disorder, where many (socio) local ecosystems, but perhaps even the most complex “Earth System”, do not respond adequately to global capitalist accumulation processes. The reason for this high environmental impact of capitalism lies in the fact that it is a system that mobilizes for production, distribution, consumption and waste disposal, enormous quantities of energy and raw materials. Moreover, it is a system oriented towards the extraction of increasing quantities of labour and surplus-labour from any entity capable of generating it, indifferent to material entities that incorporate value or as Marx said “indifferent to the particular form of value in which it is present”. The ecological crisis also entails the definitive abstraction of the work of nature, whereas the dead labour of nature (her material wealth deposited after eons of work) is under marketization and it is used to capture living labour.

The horizon that emerges because of the ecological crisis presents crucial and problematic elements for the global capital accumulation. The most important is the decreasing “natural fertility of capital”, in other words the availability of cheap fossil energy and raw materials needed to capture living labour. This dynamic shapes the ratio between dead labour and living labour, between carriers of value and valorizing labour, or, in other words, the organic composition of capital². As Marx wrote:

There is just one thing to be noted here: the natural wealth in iron, coal, wood, etc., which are the principal elements used in the construction and operation of machinery, presents itself here as a natural fertility of capital and is a factor determining the rate of profit irrespective of the high or low level of wages.

(Marx, 1894, vol. III, p. 76)

It means that with a decreasing availability of cheap raw materials and energy that constitute the “natural fertility” of capital, not only the rate of profit can fall putting the accumulation machine at risk, but also that capital has

² The “organic composition of capital” is the ratio of the value of the materials and fixed costs (constant capital) embodied in production of a commodity to the value of the labour-power (variable capital) used in making it. The “technical composition of capital” differs in that it refers to the proportions of concrete labour, rather than the value composition of capital.

started to appropriate too expensive energy and raw materials to put in motion and capture living valorizing labour. In the same direction, also the ratio between energy and labour is decreasing: more energy for less living labour, due to the increasing mechanization and automation of labour processes. Finally, less cheap fossil fuel is forging a general trend aimed at the reduction of high salary labour and the increasing hunt for cheap labour. These phenomena that stem, as at the Marx's times, from the overexploitation of resources by the capital, are shaking the pillar of global accumulation and putting in crisis the nature/society dialectic. It is understood that the crisis of the world capital also contains the constituent elements for the crisis of social systems as a whole as they depend on the capital accumulation machine. As Marx said:

In the development of productive forces there comes a stage when productive forces and means of intercourse are brought into being which, under the existing relations, only cause mischief, and are no longer productive but destructive forces (machinery and money)... These productive forces receive under the system of private property a one-sided development only, and for the majority they become destructive forces... Thus things have now come to such a pass that the individuals must appropriate the existing totality of productive forces, not only to achieve self-activity, but, also, merely to safeguard their very existence.

(Marx, 1998, pp. 60, 82, 96)

In essence, entropy generated by capital (Biel, 2015) can provoke a “catastrophe” if new conceptual tools are not developed to interpret it, anticipate it, and build up plausible alternatives.

If we seriously take the Marx's view regarding the natural fertility of capital, and we try to look at this fertility as an undergoing a process of decreasing if not falling, we can also suppose that the process of commodity/money system expansion is coming to a critical stage. It is long time that these dynamics have been studied (see for example Georgescu-Roegen, 1971; Odum, 1971; Giampietro et al., 2014; Tainter et al., 2003; Amin, 2009; Mezsaros, 1995; Altvater, 2006b; Moore, 2015; Foster, 2000), but they are always been peripheral to the study of the evolution of capitalist society. Nowadays, many scholars using different accounting methodologies are certifying this decreasing fertility of “nature” used by capital³. The reduction of the availability of cheap energy and raw materials can get radical consequences in the stability of capitalist machine. In technical terms, it means that to get energy and raw materials available for the production process increasing amounts of energy and raw material (and less human labour) are needed. Decreasing material and energy returns - measured for instance by Energy Return on Investment (EROI) (Hall et al. 2014) or by the Emergy Yield Ratio (EYR) (see Odum,

³ Between different methodologies I mention here the “footprint” family, the metabolic flows accounting perspective, the energy, emergy and exergy accountings, the LCA cluster, the EROI viewpoint.

1976) which is the ratio of the yield from a process (in energy) to the costs (in energy) - in fields such as agriculture or fossil fuels make unstable the use-value and exchange-value dialectic. Whereas material carriers of value (natural constant capital or natural use-values) become scarce and more expensive – in term of energy and raw materials - the rate of profit undergoes a reduction, accelerating the process of crisis inherent in this dualism. In other words, the restriction of material basis of production creates the conditions for a rate of profit falling, strengthening the conditions of crisis, as Marx wrote regarding the falling natural fertility of capital.

This process pushes toward financialization or in other words toward the production of future value, value that it is not now existing. This super-abstraction connects with the reduction of material supports of wealth, and it implies a strong separation between use value and exchange-value as well as between material economy and monetary economy. It means that here are the seeds of a great crisis. Energy and money violent separation generates a strong crisis. Not even an acceleration in the process of machinery innovation can slow down the fall of the rate of profit. As Marx wrote:

The value of raw and auxiliary materials passes entirely and all at one time into the value of the product in the manufacture of which they are consumed, while the elements of fixed capital transfer their value to the product only gradually in proportion to their wear and tear. It follows that the price of the product is influenced far more by the price of raw materials than by that of fixed capital, although the rate of profit is determined by the total value of the capital applied no matter how much of it is consumed in the making of the product.

(Marx, 1894, Vol. III, p. 77)

Marx was aware of the crucial fact that societies – associated producers – must rationally regulate their exchange with Nature, and that associated humans can approach human freedom only reducing their quantity of labour devolved to the social metabolic reproduction. The Marx's exhortation for a "rational regulation of interchange with Nature" (Marx, 1894, vol. III, p. 593) challenges widespread current ideas that we are now living in an economy that tends to immateriality and that economic growth is now decoupled from energy and raw materials consumption. This myth is very difficult to overcome.

■ Between materiality and immateriality

Often social scientists are reluctant to reflect upon energy, perhaps because they do not find the object of this reflection very clear. Similar to other notions such as strength, will, work, money, energy appears at the same time as something immaterial, incorporeal, abstract, spiritual, and as something

material, concrete and physical. This ambivalence is likely the reason why sociologists do not engage in studying energy or better it is its material side that put sociologists at discomfort.

According to Richard Beardsworth, energy should be approached “phenomenally”, since it is evident only in its effects. Energy is not itself stuff; it is something that all stuff has. In itself, energy remains unknown, a universal abstraction, an elusive subject, a restless activity. As such, in its essence, energy is something inaccessible and pre-material (Salminen and Vadén, 2015). As claimed by the physicist Frederick Soddy, “Energy, someone may say, is a mere abstraction, a mere term, not a real thing. As you will. In this, as in many another respects, it is like an abstraction no one would deny reality to, and that abstraction is wealth. Wealth is the power of purchasing, as energy is the power of working. I cannot show you energy, only its effects ... Abstraction or not, energy is as real as wealth - I am not sure that they are not two aspects of the same thing” (Soddy 1920, pp. 27-8). The physicist Richard Feynman stressed that we “have no knowledge of what energy is... It is an abstract thing in that it does not tell us the mechanisms or the reasons for the various formulas” (Feynman, 1963, ph. 4.1). As said by Richard Adams, energy forms, equilibrium, structures, and stability describe states or conditions, but they have little meaning, apart from the dynamics through which they are manifest. It is in the quality of inherent dynamics that the concept of the “energy form” becomes useful (Adams, 1988). It is the quality that makes the difference between the different forms of energy, or better their usefulness for the human or capitalist purposes.

My idea is simpler: access to an understanding of energy is possible only through the material experiencing of natural and technical objects we enter in contact, and the work that it puts in motion. In short, energy cannot be traced back to its pre-materiality, that is, to its abstract existence: it can be known when, after it is captured and transformed by matter or living beings, it becomes work that makes events. When energy is measured by different conventional units and metrics – Joules, Kcalories, BTU, KWh - it means that it is newly separated from his material carrier, being subjected to a new process of abstraction, becoming flows, force, field, motion. Furthermore, as suggested by Salminen and Vadén (2015, p. 8), “energy in humans is for the most part non-human, it does not originate from humanity, it does not exist in the human scale and is not for her purposes”, but it is converted, used and assessed greatly by humans.

Given these dilemmas it embodies, energy deserves to be approached and carefully scrutinized in a dynamic way, paying particular attention to its transformational processes. Even though its effects are self-evident, energy remains an unknown entity, an abstraction, in a double way: first because it is a commodity, second because of its intrinsic transformational power. Getting into energy ontology is possible by studying the materiality of its effects, its transformative capacity, its ability to put work into motion, and

its centrality for the production, distribution and consumption processes. Energy has mainly one source (the other one is the geothermal coming from the earth): the sun, but many physical carriers, converters, and forms – muscular, kinetic, thermal, electric, gravitational - that constitute its enormous transformative capacity. Hence the difficulty of catching it in one glance, in one cognitive system. Energy has a multiple ontology or an ontology made of multiple realities, so it is interesting to try to figure out how it moves and what it does. Its faceted ontology makes energy to show the same double characteristic of concreteness and abstraction held by human labour under capitalist condition of production. From one side it is a qualitative practical experience of human bodies, from the other one it is the realm of the abstract, of the material measured by different metrics. Energy, as the world in which we live, is a masterpiece of ambiguity, because at the same time it determines the existence of living bodies and provides the condition for the manifestation of socially organized abstract labour.

■ Work/energy⁴

Energy can be approached both in a concrete and abstract feature. The work that energy puts in motion is a key feature of its ontology. Work becomes the key to read the social dimension of energy. I hold here that the global economic process aims to transform energy and matter, particularly fossil energy-sources, into labour-energy, thus generating further value and monetary gains and finally social relations and contradictions. The energy

4 In this paper, I use the terms “work” and “labour” in an interchangeable way. But I’m aware of the fact that the two concepts are different in their substance. As explained by Friedrich Engels “The word ‘work’ and the corresponding idea is derived from English engineers. But in English, practical work is called ‘work’, while work in the economic sense is called ‘labour’. Hence, physical work also is termed “work”, thereby excluding all confusion with work in the economic sense. This is not the case in German; therefore it has been possible in recent pseudoscientific literature to make various peculiar applications of work in the physical sense to economic conditions of labour and vice versa. But we have also the word “Werk” which, like the English word “work”, is excellently adapted for signifying physical work. Political economy, however, being a sphere far too remote from our natural scientists, they will scarcely decide to introduce it to replace the word Arbeit, which has already obtained general currency – unless, perhaps, when it is too late. Only Clausius has made the attempt to retain the expression “Werk”, at least alongside the expression “Arbeit”. (Engels, 1987, p. 391). Engels also added a note to the fourth German Edition: “The English language has the advantage of possessing two separate words for these two different aspects of labour. Labour which creates use-values and is qualitatively determined is called “work” as opposed to “labour”; labour which creates value and is only measured quantitatively is called “labour”, as opposed to work. The editor too added a note saying “Unfortunately, English usage does not always correspond to Engels’ distinction. We have tried to adopt it where possible” (Marx, 1976, vol. I, p. 138). This latter statement provides the reason to use the two words in an interchangeable way. In any case, both Hannah Arendt and Agnes Heller discovered the difference between labour and work, but the former profoundly misread the Marx and Engels distinction.

capacity, as I consider here, is not only “the ability to induce a change in a given state of affairs” (Giampietro and Mayumi, 2008), or again, as said by Smil, “the ability to transform a system” (Smil, 2008, p. 12-13), ability that concerns the qualitative aspects of energy. In my view, energy, in its different primary sources – light, heat, tidal, and biomass – is conceived as potential abstract labour that forms the substance of value, as homogeneous human labour, expenditure of one uniform labour-power, “expenditure of human brains, nerves, and muscles” (Marx, 1976, p. 134), even if it is mediated by complex technical and organizational machineries. As Marx said, labour “is the expenditure of simple labour-power, i.e. of the labour-power possessed in his bodily organism by every ordinary man, on the average, without being developed in any special way” (p. 135), and this labour-power is energy embedded in or applied to human bodies. For Marx, abstract labour is the substance of value and is the expenditure of human energy irrespective of, abstracting from, the concrete, specific forms it takes (concrete labours). Value is thus contained in the commodity before it realises itself as exchange-value, i.e. before the commodity is sold.

Energy, even if it is constant, changes its state, moving from concentration to dissipation. The Second Law states that in any work-energy process less and less energy becomes available for work. Entropy (the measure of work unavailability) increases. Each cycle of work increases the unavailability of energy for work. This is true also for workers; each cycle of work implies the unavailability of her/his labour-force (physical and mental) and the need of the worker to renew it. From a biophysical perspective, labour is not the primary, self-renewing force. While labour does reproduce, labour does not create or recycle its own energy. Instead, the existence and reproduction of labour and consequently of capital depends on a continual input of low-entropy energy. This energy is derived from the sun (wind, water, sunlight), sunlight stored in the bonds of fossil fuels (oil, coal, gas), small amounts of heat left over from the cooling of the Earth, and chemical bonds stored on bio-mass. Energy cannot be created by labour or physical capital, but instead must be recovered from the environment (Kaufmann, 1987). The labour-force of humans is thus renewed only using new energy. The physiological capability of labour to generate value depends on this exosomatic energy.

This is reason why energy stored on fossil fuels and chemical bonds of biomass is a crucial factor to support the labour productivity – the productivity of bodies. To reach that effect capitalism must incessantly use energy (Martinez-Alier with Schlüpmann, 1987; Mirowski, 1989). Consequently, increasing labour productivity means also increasing energy consumption. This idea, widely accepted among ecological economists, has never fully taken on board by the social sciences mainstream. A slightly overstated paraphrase is “The currency of the world is not the dollar, it is the joule” (Lewis, 2007, p. 808). One can make the linkage between rising labour productivity and increasing energy use a bit more precise by comparing growth rates of average

labour and energy productivities and the energy/labour ratio (Taylor, 2008).

The relation of thermodynamics to work is explicit, and it is fostered by the capital. Capital is concerned with physical work because the labour-process is the transformation of labour-power (energy, inertia) into labour (work). This is the “eternal necessity” of capital, and physics provides models for overcoming “resistances” and measuring rods of levels of crisis (Caffentzis, 2013, p. 15). For Caffentzis, the problem is not the lack of energy or the quantity of work per se, but the proportion of work generated by energy (or labour-power), the ratio between the two. Capital is not just a product of work. Capital is the process of work-creation, i.e., the condition for transforming energy into work. Though the eternal cycle of capitalist reality is the transformation of energies into work, its problem is that unless certain quantitative levels are reached, the relationship expressed in the work/energy ratio collapses, the entropy increases.

For capitalism, human labour is indifferent and interchangeable with that of machines or nature (animals, plants, sun, wind) (Wendling, 2009). By giving primacy to the energy sector, capital can command an enormous amount of work because this centralizes the accumulation process, while at the same time it enormously decentralizes the exploitation process. “By developing the energy sector, capital is able to exert its magnetic command and extract surplus from every “pore” of the social fabric; every coffee shop, every apartment, every sweatshop must pay for energy costs” (Caffentzis, 2013). Caffentzis’ point of view is well rooted in Marx’s concept of work. Even though Marx’s position is that human labour is different from animal or machine labour, refusing to assimilate human labour fully to the model of work done by an animal or machine, he acknowledges that carriers of labour are indifferent for capital goals. To explain the appropriation of surplus-labour by the capital, Marx launches the concept of labour-power [Arbeitskraft], as distinct from labour [Arbeit], giving it an “energeticist” meaning. This passage from Arbeit to Arbeitskraft, the transformation of work from self-actualization to energy expenditure is crucial (Rabinbach, 1990). In a famous note, Marx claims “Creation of value is the transposition of labour-power into labour. Labour-power itself is, above all else, the material of nature transposed into a human organism.” (Marx, 1976, vol. I, p. 323, n. 2).

As suggested by Anson Rabinbach (1990; see also Wendling, 2009, but also Schmidt, 2014) “After 1859 Marx gradually redefined labour from a metabolic exchange of substances between man and nature to a conversion of force” (Rabinbach, 1990, p. 77). According to Rabinbach, here we can see a radical transformation of the Marx’s concept of labour, the upcoming distinction of concrete and abstract labour. “Marx sees the labouring body as a natural force among others united by the universal equivalence of Kraft. Labour is no longer a creative or singularly human act, it is one kind of work aimed at the production of use values. In Capital Marx describes labor as intensifying and regulating energy expenditure. The process of metabolism

is redefined as a constant recycling of forces” Rabinbach, 1990, p. 77). But what is interesting is that “Marx observes that laboring activity is distinct from Arbeitskraft, or labor power, only insofar as the latter actually has value. Whereas labouring activity is still a concrete exchange with the raw materials of nature, labour power conceives of the body as a natural force in itself. Since only labor can be quantified and universalized in relation to all other forces and instruments of production, only labour power is potentially a productive force” (Rabinbach, 1990, p. 78).

Labour as activity aimed to the exchange of matter between nature and society, under capitalism conditions starts to be reduced to abstract labour making it the carrier of value whereas it can be measured as time unities of expended energy. Social labour – the labour is always social also before capitalism – loses its metabolic features becoming abstract labour featured by its energetics dynamics and the human body becomes a kind of thermodynamic machine, with both the loss and the renewal of energy resources. As Marx underlines: “Man himself, viewed as the impersonation of labour-power, is a natural object, a thing, although a living conscious thing, and labour is the manifestation of this power residing in him” (Marx, 1887, vol. I, p. 225). The abstract labour that generates value, or the value that represents abstract labour, is expended energy that must be always renewed. Nature is labour, and labour is nature, mediated by energy. As suggested by Guglielmo Carchedi, “Due to the principle of the conservation of energy and given that value is abstract labour under capitalism, it follows that that substance coagulates in the product and becomes its embodied value”. Thus, abstract labour can be seen as an observable and measurable expenditure of physiological and undifferentiated human energy (Carchedi, 2009).

This conflation of concrete and abstract labour, of metabolically and socially organized labour, that makes plausible the idea that social labour is for Marx an energetic carrier, can be revealed when he suggests that labour adds new value and conserves old value e.g. that embedded on means of production or in refined raw and auxiliary materials, at the same time. As Marx wrote:

The various factors of the labour-process play different parts in forming the value of the product. The labourer adds fresh value to the subject of his labour by expending upon it a given amount of additional labour; no matter what the specific character and utility of that labour may be. On the other hand, the values of the means of production used up in the process are preserved, and present themselves afresh as constituent parts of the value of the product; the values of the cotton and the spindle, for instance, re-appear again in the value of the yarn. The value of the means of production is therefore preserved, by being transferred to the product. This transfer takes place during the conversion of those means into a product, or in other words, during the labour-process. It is brought about by labour; but how? The labourer does not perform two operations at once,

one in order to add value to the cotton, the other in order to preserve the value of the means of production, or, what amounts to the same thing, to transfer to the yarn, to the product, the value of the cotton on which he works, and part of the value of the spindle with which he works. But, by the very act of adding new value, he preserves their former values. Since, however, the addition of new value to the subject of his labour, and the preservation of its former value, are two entirely distinct results, produced simultaneously by the labourer, during one operation, it is plain that this two-fold nature of the result can be explained only by the two-fold nature of his labour; at one and the same time, it must in one character create value, and in another character preserve or transfer value.

(Marx, 1887, vol. I, pp. 221-222)

This Marx's point of view is interesting because it highlights the capability of human labour to produce new value but also to conserve and transfer old value or labour from the means of production to the new goods, to the new forms matter takes. Here labour works like energy, able to transfer, transmute, generate and conserve itself through all its movements in time and space. This capacity to generate and conserve value is proper of human labour for its double feature: from one side it is by virtue of its general character, as being expenditure of human labour-power in the abstract, that spinning adds new value to the values of the cotton and the spindle. As Marx wrote:

... but because it is labour in the abstract, a portion of the total labour of society; and we see next, that the value added is of a given definite amount, not because his labour has a special utility, but because it is exerted for a definite time [...] and on the other hand, it is by virtue of its special character, as being a concrete, useful process, that the same labour of spinning both transfers the values of the means of production to the product, and preserves them in the product.

(Marx, 1887, vol. I, p. 223)

Here, the labour process produces at the same time a two-fold outcome, the first due to the abstract labour-force expended in the process and thus necessarily reproduced the day after; the second one because of his creative and mental capacity to transform matter and energy. These annotations are very insightful in order to depict a new ontology of labour, where concrete and abstract are two sides of the same coin. In its double or two-fold character, labour is able to provide new value and at the same time conserve old value. This double character of labour implies at the same time an empirical unity and two irreducible labour ontologies. The fact that the concrete and abstract reside and happen in the same activity and in the same socio-spatial dimension, tells us about the impossibility of an empirical distinction between these two characters of labour. However, it is undoubtable that the two labour-forms are conceptually irreducible. At empirical level, the labour is the same for the two effects; at the conceptual level, we can radically distinguish two different onto-

logical forms of labour, one special and the second one general. The generation and conservation of value tells us also that labour is able to conserve from the “dead” old values and at the same time generate new value, as energy flows do, conserving, transforming, and generating work. As Marx wrote:

Hence, the labourer preserves the values of the consumed means of production, or transfers them as portions of its value to the product, not by virtue of his additional labour; abstractedly considered, but by virtue of the particular useful character of that labour, by virtue of its special productive form. In so far then as labour is such specific productive activity, in so far as it is spinning, weaving, or forging, it raises, by mere contact, the means of production from the dead, makes them living factors of the labour-process, and combines with them to form the new products [...] By the simple addition of a certain quantity of labour, new value is added, and by the quality of this added labour, the original values of the means of production are preserved in the product.

(Marx, 1887, vol. I, p. 223)

Like energy, here Marx refers to the quantitative and qualitative aspects of labour. In the quantitative side, labour is accounted in unity of time devoted to the production of value whereas at qualitative side labour is accounted for its capability to change form of the matter it manipulates to produce use-values. The concrete analogy with energy is clear, as well as it is accounted in terms of intensity deployed along units of time and its capacity to transform in different forms.

■ Social relation

Beyond the thermodynamic complex that it can represent, the work/energy ratio is also a social relation. It is the matrix in which a variety of human agents and mechanical artefacts are organized in order to perform practices of production to generate value. But production entails form of nature appropriation. It thus becomes the social matrix that generates at the same time forms of work to produce commodities and forms of work to appropriate nature, the way in which nature is dis/organized in order to be appropriated. Here energy becomes the material link between the social nature of human organization and the social nature of nature organization. The power that innervates the organizational processes to appropriate nature. Energetic relations become relations of power in which processes of nature appropriation are deployed. Here energy can be seen as historical determination that applies to concrete societies and their organization.

Forms of energy (muscles, wind, water, and fuel powered machines) depend on prevalent historical social relations between classes and modes of reproduction. Those relations that select the prevalent energy form, from

which depends the time space configurations and the general livelihood of a society or a social system or a collective mode of existence, are relations of exchange between society and nature. The use of energy is socially organized and technologically structured. It enables the delivery of natural resources to social groups in forms that can be readily used (as food, goods, and so on). In short, the use of energy allows natural resources to be socially configured and allocated in ways that can both enhance and limit the evolution of human societies (White, 1943; Adams, 1975; Lutzenhiser, 1994). Despite the fact that energy can be defined as “the ability to do work”, natural scientists are rarely concerned about the type of work being made possible and how this changes in time and space (Shove and Walker, 2014). In few words, we can say that energy configurations at the end aim to allow bundles of social activities, arrays of social practices aimed to produce and consume commodities.

The social essence of energy makes us able to avoid an “energetic determinism” that divorces from its true social, political, and economic basis. As said by Matthew Huber, “while energy matters, it is important to retain a perspective of dialectical complexity that emphasizes the mutually constitutive relations between energy and society” (Huber, 2008). The shift from productive systems based on the application of human and animal muscle power to systems based on “inanimate”, or non-living, power represents a fundamental transformation in what Marx called the “labour process”, or what ecological Marxists call the socio-natural metabolism (Foster, 2000; Heynen et al., 2006; Swyngedouw, 2006).

Energy appropriation and consumption is always mediated by labour and machinery. Only the simplest forms of energy may be harnessed without infrastructures. Energy resources are always transformed by a combination of technical systems (Smil, 2010; Tyfield, 2014) and human labour that give them the particular social configuration in order to make human and technical apparatuses working, to sustain the metabolic reproduction of a number of different social subsystems. But energy has many material carriers – sun, oil, coal, gas, wind, bio-mass – that in capitalist society become commodities essential in the production of all other commodities (including labour power). Energy – as work - is intrinsically ambivalent: it is a use-value freely provided by nature vital for all living systems (social and biological), but it is also a commodity that shares rules of production, circulation, and consumption with other commodities. It is at the same time a gift of nature and a commodity that can be controlled through technical processes according to a purely economic logic.

For long time, energy has been considered as neutral, unlimited and inexhaustible, devoid of any particular impact on the future of society, subordinate to this future, adaptable at will (Debeir et al., 1991) but it is now becoming for several reasons a very sensitive issue. The falling natural fertility of capital represented by land shortage or increasing prices of energy

and raw material can only have consequences upon the social order based on large availability of energy for all current daily life people activities. It is notorious that social practices and their maintenance are possible only whereas complex socio-technical apparatuses support these practices. Energy and raw materials shortage, due for instance to climate change, catches the potential to shake the ordered flows of social life, increasing controversies and conflicts of different nature (Schnaiberg, 1975; Padovan and Arrobbio, 2017).

■ Energy and commodity-form

The commodity is value. It would be wrong to say that commodities have value, since the value is not an attribute of the commodity, but it is its essence. In addition, this essence is social. Value is made up of abstract social labour, hence its social character. It is the abstract labour that Marx distinguishes from concrete labour directed at the production of use-values that produces value. Concrete labour is the expense of human energy in a certain form, while abstract work is the expense of human energy as such, regardless of the forms it originates. Defined in this way, abstract labour is a physiological concept, purified of all his qualitative determinants. As a result, abstract labour exists only as quantities of time-work or clock-work embodied in a commodity. This quantitative characteristic of abstract labour approaches considerably to the concept of energy. Nevertheless, work as physiological activity, says Rubin, is not enough to create value. It must assume a “social” character, i.e. it must be considered in its modes of delivery and organization at the technical, material and social level. Abstract social work produces value only because it is socially organized, because of ownership relationships, techno-material systems, and money, all together transforming the differences that are apparent at first sight into a general affinity, a universal equality. In other words, the value can be analytically derived from labour only if the latter acquires a particular social, energetic and techno-material configuration that can make it abstract (Rubin, 1973). However, also this process of so-called socialization is not enough to create value: abstract labour must be exchanged in the form of commodities to reach its full social character and thus to generate value.

The debate around the relation between value and abstract labour is still sparkly. It moves between the idea that labour becomes abstract in virtue of exchangeability of its products, whereas the commodity it makes enters the sphere of exchange and circulation mediated by money (Sohn-Rethel, 1978; Toscano, 2008); or labour becomes abstract when it is organized at the social and technical level implying “tautological” and “self-referential” functions with destructive results for humanity and nature (Kurz, 1991; Jappe, 2013). In his long journey through Marx’s texts, Rubin moves between these two horns of the problematic - the “circulationist” and “productivist” perspectives - wi-

thout solving the dilemma (Kicillof and Starosta, 2007). For Rubin:

The transformation of private labour into social labour can only be carried out through the transformation of concrete labour into abstract labour. On the other hand, the transformation of concrete into abstract labour already signifies its inclusion in the mass of homogeneous social labour, i.e., its transformation into social labour. Abstract labour is the variety of social labour or socially equalized labour in general. It is social or socially equalized labour in the specific form which it has in a commodity economy. Abstract labour is not only socially equalized labour, i.e., abstracted from concrete properties, impersonal and homogeneous labour. It is labour which becomes social labour only as impersonal and homogeneous labour. The concept of abstract labour presupposes that the process of impersonalization or equalization of labour is a unified process through which labour is “socialized”, i.e., is included in the total mass of social labour. This equalization of labour may take place, but only mentally and in anticipation, in the process of direct production, before the act of exchange. But in reality, it takes place through the act of exchange, through the equalization (even though it is mental and anticipated) of the product of the given labour with a definite sum of money. If this equalization precedes exchange, it must yet be realized in the actual process of exchange.

(Rubin, 1973, p. 8).

My perspective is that abstract labour is at the same time expended energy of bodies and organized energy of society, this latter creating the conditions for its homogenous and normalized expenditure and measurement. Energy expenditure of human bodies enters the process of production already organized in social terms, aimed to capture and make abstract human specific activities. The point is energy, in its abstract character of measurable flows entering the production process. Energy generates, equalizes, organizes social abstract labour as well as abstract labour preserves or multiplies energy. Energy as it is organized at this stage of capital development provides structural conditions for the genesis of abstract work, homogeneous work, and normalized social work. But energy is not just only an infrastructure, it is the element that allows to change matter and thus absorbs human labour. Energy moves into goods embedded in abstract workflows. It does not directly produces value, but it is the matrix in which labour becomes social, equal, and abstract, thus generating value. The physiological homogeneity of work is the bio-energetic premise of the possibility of making it social and abstract. Energy is therefore the natural premise of abstract and equalized social work.

■ Dead labour and dead nature: how to absorb work and value

Now, the fact that the commodity form implies a constant reduction in the need for living-labour in the face of the mass of dead labour that is capable of absorbing, means a reduction in capital valorization that has always been fought with the spatial enlargement and the temporal acceleration of the process of production of goods. Dead labour is the physical form that the capital acquires. As said by Marx, “Capital is dead labour, that, vampire-like, only lives by sucking living labour, and lives the more, the more labour it sucks”. (Capital, 1976, vol. I, p. 342). Dead-labour (i.e. capital) is also dead work of nature. Raw materials and energy that are appropriated through socially organized labour are the dead-work of nature made in millions of years. To the extent that the form of commodity has become the form of social totality, it implies not only the reduction of future value due to the fictitious capital increasing, which would like to control and exchange “future” work and nature, but also an over-exploitation of raw materials for machinery and an under-production of organic raw materials that enter the process of production, which implies a slowdown in the expansion of the accumulation process. As Marx wrote:

The greater the development of capitalist production, and, consequently, the greater the means of suddenly and permanently increasing that portion of constant capital consisting of machinery, etc., and the more rapid the accumulation (particularly in times of prosperity), so much greater the relative over-production of machinery and other fixed capital, so much more frequent the relative under-production of vegetable and animal raw materials, and so much more pronounced the previously described rise of their prices and the attendant reaction. And so much more frequent are the convulsions caused as they are by the violent price fluctuations of one of the main elements in the process of reproduction.

(Marx, 1894, vol. III, p. 84)

Here, Marx highlights the potential contradiction between the constituent parts of constant capital: the machinery, the raw materials needed for its production, the energy that drives the machinery on one side, and the organic raw materials as cereals or cotton that enter the production process, goods intended for final consumption of labour-force, in the other side. In times of strong growth and capital accumulation, the former are marked by over-production, while the latter are under-produced. Here the potential of crises contained in the form of commodity and its continuing metamorphosis, the contradiction between use-value and exchange-value, purchase and sale, work of nature and human labour manifests. Here is the increasing concentration of machinery in the production process that constitutes the element of crisis, creating a contradiction between different forms of constant capital.

Energy, raw materials and machinery can be seen when recruited as constant capital as dead labour intended to absorb rising portions of living labour. Several authors have rediscovered the category of dead labour, but they did so in different directions (Veca, 1971; Smith, 2007; Mitchell, 2000, 2012; Neocleous, 2003; Kirsch and Mitchell, 2004). I propose here a reflection on the relationship between dead labour and living labour and how it can be introduced in a useful way to explain the controversial, dialectical and changing relationship between energy, raw materials, and living labour as well as it unfolds in capitalist society. Energy can be seen as a generator of work and therefore considered transitive as a moving agent that pass from bodies to objects, or from a material carrier to be applied to machine. But it can also be seen in an intransitive way, as spent and crystallized energy in raw materials and machinery that can absorb new valuable work. Finally, it can be also considered as an element that enhances dead labour, as living energy that recovers discarded objects and revives dead matter.

The dead labour is for Marx the labour-power - energy expended - frozen in a commodity, materialized labour embedded with its subject. Dead labour is energy trapped, metamorphized by its kinetic form in its potential form. In capitalism this potential form of energy is commodity, a solid thing. It is not just about flow and circulation, but also about permanence, conservation, and morphology. Through labour, energy is transferred to raw materials and something new appears. Energy, less than dispersed, is “frozen” or “solidified” in the commodity. The struggle - both direct with matter and the most widespread and abstract implicit in social relations - stops, a body given in the form of goods materializes - whether it is a dress or a glass bottle. “Labour is the living, form-giving fire; it is the transitoriness of things, their temporality, as their formation by living time” says Marx (1993, p. 361). “By turning his money into commodities that serve as the material elements of a new product, and as factors in the labour-process, by incorporating living labour with their dead substance, the capitalist at the same time converts value, i.e., past, materialised, and dead labour into capital, into value big with value, a live monster that is fruitful and multiplies”. (Capital, 1887, vol. I, p. 217).

There is a clear difference between the tout-court labour process and the labour process involved in the process of valorization:

If we consider the process of production from the point of view of the simple labour process, the labourer stands in relation to the means of production, not in their quality as capital, but as the mere means and material of his own intelligent productive activity. In tanning, e.g., he deals with the skins as his simple object of labour. It is not the capitalist whose skin he tans. But it is different as soon as we deal with the process of production from the point of view of the process of creation of surplus-value. The means of production are at once changed into means for the

absorption of the labour of others. It is now no longer the labourer that employs the means of production, but the means of production that employ the labourer. Instead of being consumed by him as material elements of his productive activity, they consume him as the ferment necessary to their own life process, and the life process of capital consists only in its movement as value constantly expanding, constantly multiplying itself. Furnaces and workshops that stand idle by night, and absorb no living labour, are "a mere loss" to the capitalist. Hence, furnaces and workshops constitute lawful claims upon the night labour of the work-people.

(Marx, 1887, vol. I, p. 339)

While continuing to be a relationship of appropriation of work and nature (energy and raw materials), capital configures as dead, spent, past work, materialized and realized through exchange. But this is a dead labour that can absorb free living work (surplus labour) that generates value, and that absorption is the main part of the capital valorization process. We can see here the complete inversion of the relation between dead and living labour, between value and the force that creates value, which is peculiar and characteristic of capitalist production.

The fact that the means of production - machines, raw materials and energy - are able to absorb work throws an interesting light on the process of generating value: it is living labour that generates value but is the raw materials that absorb this value in living work form, energy-enhancing energy, energy from work that is nevertheless daily reproduced. Here perhaps is the arcane of value. The only valorising energy is the working one because it is the only one, unlike the energy of organic and inorganic raw materials that need long periods of regeneration, which can regenerate day after day. It is this force, this energy that infuses value because it never dies ... indeed it is always regenerated. Marx wrote:

The worker needs to work only e.g. half a working day in order to live a whole one; and hence to be able to begin the same process again the next day. Only half a day's work is objectified in his labouring capacity - to the extent that it exists in him as someone alive, or as a living instrument of labour. The worker's entire living day (day of life) is the static result, the objectification of half a day's work. By appropriating the entire day's work and then consuming it in the production process with the materials of which his capital consists, but by giving in exchange only the labour objectified in the worker - i.e. half a day's work - the capitalist creates the surplus value of his capital; in this case, half a day of objectified labour. Now suppose that the productive powers of labour double, i.e. that the same labour creates double the use value in the same time. (For the moment, use value is defined in the present relation as only that which the worker consumes in order to stay alive as a worker; the quantity of the means of life for which, through the mediation of money, he exchanges the

labour objectified in his living labouring capacity.

(Marx, 1993, pp. 333-334).

Here there is the obvious contradiction between the availability of constant capital – fixed and circulating – in the form of energy, raw materials and machinery, and a valorising labour-force in the form of supplemental labour (unpaid human labour). The loss of productivity of natural resources, i.e. the increase in initial capital to buy means of production, makes it more difficult for capital “to swallow up daily a definite quantity of the unpaid labour of others ...” (Marx, 1887, vol. I, p. 340).

Marx defines capital as “dead labour” in various passages. Marx places the dead work - as absorbed in the capital - as a parasite of living work, which is the only one that generates and preserves value. Capital needs this endless investment on living labour, regardless of the amount of dead work it is able to acquire, and the form it can take on: natural wealth, means of production, accumulated technical knowledge. Material accumulation will never satisfy the needs of capital, because what drives the system at the structural level is the continuous extraction of living work - an endless, instrumental objective that operates without regard to any particular limit of material wealth. In this perspective, dead work is constantly accumulated - obsessively accumulated - because structurally, despite the apparitions that express and overshadow this structure, the accumulation of dead work is not the end, but instead a means of extracting and absorbing new living work.

In this social structure, the accumulation of dead labour - energy, raw materials, infrastructures, and means of production in the form of constant capital - is a direct consequence of the structural push towards the displacement, reorganization, reconstitution and growth of the mass of abstract living labour that must enter the process of valorisation. In the context of the capitalist economic system, raw materials, energy, physical plants, logistic networks, primary products of production and machinery become “power plants” of capital accumulation, machines absorbing a certain amount of labour. As mentioned before, capital is structurally indifferent to the concrete form in which this work is spent, although it requires that such work be spent in some form.

■ Energy/Work as the nexus between nature and society

Labour is the material foundation of the human metabolism with nature. The social metabolism or the resource throughput between physical nature and human society is activated and mobilised by labour and energy, both endosomatic and exosomatic. Society has to exchange with nature for its own reproduction, but this exchange has the transhistorical ‘generic determination of labour’. This metabolism takes a historical and particular cha-

racter under capitalism conditions. As suggested by Swyngedouw (2006) the metabolic process is energised through the fusion of the physical properties and creative capacities of humans with those of non-humans, but this fusion works differently across the time. Under capitalism, labour transforms energy and raw materials into use values but at the same time, in the same moment, labour provides them a value specific for the social exchange becoming commodities. As Marx already suggested, without inputs of concrete labour (or energy to drive machines to replace concrete labour) there would be no metabolism:

The labour process, as we have just presented it in its simple and abstract elements, is purposeful activity aimed at the production of use-values. It is an appropriation of what exists in nature for the requirements of man. It is the universal condition for the metabolic interaction [Stoffwechsel] between man and nature, the everlasting nature-imposed condition of human existence, and it is therefore independent of every form of that existence, or rather it is common to all forms of society in which human beings live.

(Marx, 1976, vol. I, p. 290)

Albeit labour has changed over time, it remains the main action that appropriates and transforms nature – energy and raw materials - while produces value. Firstly, labour is an appropriative action implied in practices of selection, extraction and relocation of an amount of natural elements putting them at the disposal of other practices (Benton, 1989). The array of services freely provided by nature and freely appropriable and usable by society (such as bio-mass or nitrogen) can be counted as pure appropriation. These ecosystem services, now become a diffuse concept for attracting attention on societal dependence from ecological life support systems (Daily, 1997; de Groot et al., 2002; Gómez-Baggethun et al., 2010), are one of the clearest examples of the free metabolic exchange between society and nature. As suggested by Marx:

All those things which labour merely separates from immediate connection with their environment are objects of labour spontaneously provided by nature, such as fish caught and separated from their natural element, namely water, timber felled in virgin forests, and ores extracted from their veins.

(Marx, 1976, vol. I, p. 284)

By contrast, the agricultural labour-processes are primarily deployed to sustain or regulate the environmental conditions under which seeds or stock animals grow and develop. There is a transformative moment in these labour processes, but the transformations are brought about by naturally given organic mechanisms, not by the application of human labour (Benton, 1989, 67–68). Finally we have a concept of the labour-process where is central the notion of a raw material undergoing a transformation to yield a use value. This transformation is the outcome of a human labour, which involves the utilization of raw materials and instruments of labour to achieve its purpose. The process involves both human intentional activity, and a range of distinct

materials, substances and other nonhuman beings and conditions. Benton's description of different proportions and activity performed by humans and nature in the process of production aims to understand how labour mediates and bridges society and nature. In this view labour is seen as a meta-historical process of human adaptation to environmental conditions of social reproduction. The labour capacity to adapt humans to nature, before its distortion due to its subsumption and abstraction caused by capitalism, was clearly underlined by Marx:

Labour is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature. He confronts the materials of nature as a force of nature. He sets in motion the natural forces which belong to his own body, his arms, legs, head and hands, in order to appropriate the materials of nature in a form adapted to his own needs. Through this movement he acts upon external nature and changes it, and in this way he simultaneously changes his own nature.

(Marx, 1976, vol. I, p. 283)

In the labour process, therefore, man's activity, via the instruments of labour, effects an alteration in the object of labour which was intended from the outset. The process is extinguished in the product. The product of the process is a use-value, a piece of natural material adapted to human needs by means of a change in its form. Labour has become bound up in its object: labour has been objectified, the object has been worked on.

(Marx, 1976, vol. I, p. 287)

Under capitalist conditions, labour becomes an intentional form of socially organized activity usually involving the use of tools such as technic, science, expert knowledge (Sayers, 2007), aimed to transform energy, matter and living organisms in commodities for social needs, but also able at the same time to generate economic value. While labour is understandable as the transformative taking on the world, the engine of the concrete material colonization of nature, it is also a dynamic tool for the abstraction of the world. As suggested by Robert Kurz, in contrast to pre-modern societies, the "process of metabolism with nature" is no longer codified by religious traditions and traditional grammars, but is now mediated through the mechanism of the market, which progressively incorporates the whole relation to nature by the process of abstraction of the commodity form. Capitalism entails the transformation of the material and sensible content of reproduction into "abstract things", whose phenomenal form is money indifferent to that content. Paradoxically, the process of abstraction of labour rends men much more dependent on social relations within the "process of metabolism with nature" than they were in pre-modern society, which was characterized in this respect by small autarchic units of production (Kurz, 1994).

If metabolism is nothing else than the continuous process of assembling

and reassembling past and present energy, matter and labour, where labour is energy transferred to a human organism by means of nourishing matter, under capitalist social relations the separation of society from nature is accomplished but only to subsume it under new forms of exploitation. While separation is at work it allows the forced unity of society/nature complex ascribed by dualistic ways of thinking to each term. Thus, under the term “production of nature” we can see the dialectical movement between separation and unification of society/nature complex (Moore, 2009; Castree, 2001; Benton, 2001).

The subsuming process arises, as noted by Kurz, a blind social machine for the abstract utilization of labour power, whose tendency consists in absorbing within its vacant movement man, nature and everything that it touches, directing them and later evacuating them into the other dead form of labour and matter, without adding any other qualitative end. This social machine has to put material quality into motion: raw materials, natural forces and living human labour; such qualities, however, do not constitute a goal nor do they produce any end by themselves, they are only means in the tautological and self-referential process of abstract labour. There is, therefore, a reversal of means and ends: labour is no longer a means towards the qualitative end of the appropriation of nature, but, on the contrary, the qualitative and material appropriation of nature is only an indifferent means for the process of the change of form of abstract labour as an end-in-itself (Kurz, 1991).

■ Conclusions

In this paper, I wanted to show how the so-called ecology world crisis interacts with capitalist crisis. It is not my idea to say that energy and raw materials have agency regarding the capital crisis, as some scholars likely would assert if asked on the issue, but they get certainly consequences on the socio-ecological dynamics (Hornborg, 2017). Nature is not aware of what is happening, but capital and working classes are experimenting this in a two-fold way: the worsening of condition of labour subject to strengthening conditions of abstraction and to consequences of ecological crises. The changing conditions of energy and raw materials availability shape the global process of capital accumulation and the way in which capital recruits abstract living labour to maintain the conditions of accumulation. Marx’s definition of abstract labour arose an amount of controversies along the time, but my idea is that this definition is close to the definition of energy as offered by the first energy scientists. In any case, whether abstract labour is physiological, or techno-material, or social, or simply abstractly human, or again a consequence of exchange with other commodities or money, the nature of abstract labour is rather materialist, even if a “dematerialized materialism”, a materialism embodied in the primacy of energy. Consequently, I am concerned to investigate the material social dynamics of the energetics carriers

of value, of the absorbers, capturers, engagers, attractors of living abstract labour. I'm interested into the dynamics of dead labour as raw materials, energy, means of production that are also mediated by labour and money (being them commodities too), but they do not add value to the commodity, they are only bearer of abstract labour and thus of value. However, in doing so, they are crucial for the process of valorisation: without coal, oil, iron, cotton, cereals, accumulation process ends. Consequently, variations in terms of natural fertility of capital deeply shape its health and wealth. The presence of a fall that produces free energy is an advantage for the capitalist that owns it or can use it. Without raw materials and energy that work withdraws from earth, not labour-power would exist. The crisis that is lying on the horizon is a crisis not only of abstract labour, that resists to be recruited by capital, but also a crisis of natural fertility whereas it means increasing labour and energy to recruit nature in the process. Abstract labour and abstract nature are here therefore allies even against their wills.

Energy and raw materials are the battleground on which the survival of global capital will depend on, and they are at the same time the battleground among competing capitals – national and sectorial capitals – to get access or to conserve resources. As Gedicks (1977) argued, Marx not only recognized the importance of low-cost resources for capital accumulation to take place, but felt the scarcity of these resources at a low price could threaten advanced capitalist countries, particularly if technological advances could not keep pace with a declining resource base. This means that the horizon upon which the globalized capital is moving is still that of crisis, but means also that these socio-material fields - such as energy and raw materials availability – are becoming more crucial than others for a transitional politics beyond capitalism. Many strategies emerging to accomplish this transition are in capital-surviving side. Only few – at least until now - aim to go beyond the present system replacing forms of alienated and abstract work and nature with less work and energy-based reproducing processes.

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