Chapter 8
Ontological Fallacies Linked to Energy, Information and Related Technologies

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Abstract People and the socio-technical systems they constitute are being literally identified with motors and information processors in the present age of complex systems. This means, among others, that (a) energy and information are seen as actual ontological entities whereon the survival and the evolution of social aggregates depend and that (b) these entities entirely frame mainstream research and policy approaches aiming to increase the sustainability of human activities. This chapter (1) discusses how and why these extremely useful conceptual entities should be considered as metaphors when applied to study societies; (2) identifies some main social dynamics causing that these metaphors are instead constantly taken literally; (3) describes the implications of this literal interpretation for the ongoing energy transition. In particular, it shows how the literal interpretation of these metaphors reinforces dependency on abstract resource units supplied by energy and information technologies as well as a continuous growth in their consumption. In addition, this chapter illustrates how the unwanted effects of this literal interpretation can be effectively escaped by researchers, policy makers and all people involved in the current energy transition by focusing on the design and implementation of policy actions where the installation of technical solutions with reduced energy input and/or emissions is made complementary or subordinated to a reorganization of the energy outputs. This chapter also shows how this can allow exploiting an otherwise neglected huge variety of context dependent policy solutions relying on people capacities and on their more active involvement in policy making.

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Introduction

Complex systems are being constructed on a massive scale principally thanks to the large-scale employment of information computer technologies allowing people to perform an increasing number of tasks. These systems are made of huge amounts of standardized information, energy and material units circulating within highly interconnected and intricate networks. They result from a series of scientific and technological advancements that are leading to a complete reorganization of societies based on the properties of very abstract entities which cannot be sensed by people and have been named energy and information by physicists, engineers, biologists, ecologists and cyberneticians. This reorganization reframes the way in which the problems caused by the increasing burden on the environment by human activities have to be faced.

The present chapter examines this transformation under a very particular point of view. Rather than endorsing the theoretical perspective informed by the concepts and operational definitions whereby these systems are being socially constructed, the reasoning presented hereunder aims to put these concepts under the microscope and to show how their deconstruction can serve to identify important biases and alternative policy approaches to energy sustainability. This reasoning has been inspired by a series of paradoxical situations generated by technologies and the scientific discourse supporting their large scale utilization. These paradoxical situations are determined by the fact that the energy and information concepts hold rigorously only within laboratories, whilst scientists and people in general tend to mistake these concepts for entities actually populating everyday life when they literally identify human aggregates and societies with motors and information processors. The thesis supported in this chapter is that the literal interpretation of what should instead be considered as metaphors is responsible for a huge process of homogenization and reification. Rather than being considered as metaphors with potentially different referents in different contexts of everyday life, input–output systems represented by motors and information processors are literally identified with the aggregates made by people and their technologies while energy and information are changed into standard and abstract resource units to be consumed everywhere to accomplish any kind of activity. The literal interpretations of these metaphors reinforce each other and take place on a large scale within present competitive market settings basically because it is constantly validated by the huge technological apparatus whereby complex systems are being socially constructed. These interpretations shape our imaginary and the way we organize our societies and, in so doing, increase our dependence on the supply of abstract resource units and artificially reinforce a process of continuous growth in natural resources consumption.

As explained in this chapter, the misplaced concreteness attributed to given amounts of energy and information units, whenever they are considered as the input that people necessarily need to perform any kind of activity, is the result of an interplay between linguistic phenomena and sequences of technologically mediated

activities by which it is constantly validated. This particular interplay results from attempts to bridge what actually is an unbridgeable gap separating experimental setups and conceptual artefacts developed by scientists from what people do and say during their everyday life. Due to this type of separation between spaces, materials, and roles of involved actors, the dynamics generated by these attempts can be described through the language and the mechanisms of myth.[1]

This being said, it is probably necessary to stress that the author of this chapter does not certainly want to suggest a technophobic view. His aim is rather to show how the study of the phenomena described can help identify important complementary approaches to mainstream policies for energy sustainability and relevant weaknesses thereof.

The first two sections of the chapter are hence dedicated to discuss how energy and information play the role of central metaphors that are being constantly taken literally in the present age of complex systems and which are the consequences of this aberration for social organizations. The third section discusses how this constant literal interpretation and its validation by existing energy and information technologies[2] can inhibit the expression of a human faculty named practical knowledge and is associated with the exertion of a radical monopoly by these technologies on the practices that people can elaborate to provide for their necessities. The fourth section puts these phenomena under a more general framework and shows how they result from a particular type of counterproductivity generated by technologies largely employed by people that has been studied and identified for the first time by a series of scholars during the 1970s. This section also discusses how the main characteristics of this counterproductivity have been changed by the social transition from instrumental tools to complex systems that has been taking place since the mid-twentieth century, as described in the first chapter of this book. The fifth section discusses instead how and why the constant literal interpretation of energy and information metaphors and myths should be escaped and which are the implications for the solutions that people can identify to increase the sustainability of their lifestyles. Finally, the sixth section of the chapter draws some main conclusions from the questions previously addressed and discusses some relevant policy implications.

Energy Metaphors

Whenever we turn a switch on to get light, fill our automobiles with gasoline, install a PV panel on the roof of our house or attend a debate where scientists and politicians discuss about the need to construct new power plants, we implicitly

[1]The reasons for this can be understood by reading, for example Durkeim (1915).

[2]By energy technology it is generally meant here any energy end-use technology or technology used to produce, transmit or distribute some type of energy carrier (e.g. electricity, gas, etc.).

receive a confirmation concerning the indispensable presence in our daily life of a protean and scarce resource that has been named energy. This confirmation is also given whenever we are identified with human motors and rewarded by counting the number of the specific outputs we produce through our job or by measuring the number of hours we spend within an office or while supervising the proper operation of a machinery. Even our leisure, when organized according to more or less tight time schedules for the activities we plan, is informed by a mindset and social imaginary that has consolidated through the intensive production and large scale application of steam engines and motors starting from the mid-nineteenth century. Despite the implicit validation provided by most of our habitual practices and by contemporary public discourses concerning energy, the actual nature of this entity has been highly debated and has been redefined several times by scientists. The physicist and Nobel Prize winner Richard Feynman has for example stressed the importance of acknowledging that we "have no knowledge of what energy is" and that energy "is an abstract thing in that it does not tell us the mechanism or the *reasons* for the various formulas".[3] Percy Williams Bridgman, another physicist and Nobel Prize winner, has pointed out that "the energy concept has no meaning apart from a corresponding process. One cannot speak of the equivalence of the energy of mass and radiation unless there is some process (not necessarily reversible) by which one can get from mass to radiation".[4] The objective of this section, however, is not certainly that of contesting the validity of the outcomes of the scientific activities related to energy and, for example the validity of the law of energy conservation to which no exception seems to have been so far identified within laboratories.[5] The above quotations are just reported to point to the difficulties arising when it is pretended to identify the operational definitions produced for energy with something whose existence can be derived from experience and the

[3]See Feynman (1964).

[4]See Bridgman (1961).

[5]It remains, however, extremely interesting to follow the evolution and the transformations undergone by the formulations of the energy conservation principle, for example in the account provided by Mirowski (1989). This account illustrates how. during the first decades of the nineteenth century, the verification of the constancy of the ratios between the amounts of heat, mechanical work, electricity, radiation, etc., that can be generated from given amounts of these same physical quantities within specific physical transformation processes conducted under very controlled conditions provided the experimental basis to interpret these transformations as *conversion* processes whereby amounts of a same and conserved ontological entity were converted from a form to another. This account also shows how the energy conservation principle has undergone after that time a series of reformulations that have transformed it into a consequence of specific fields symmetries and of time homogeneity up to the quite recent and serious cosmological theories that have proposed that the universe has been generated from a vacuum fluctuation and that there is no globally conserved energy (Mirowski 1989, p. 129). What would then remain of the ontological entity named energy and of its conservation principle would just be the previously mentioned conversion factors widely employed by engineers to calculate how much mechanical work, heat, electricity, etc., can be generated within specific transformation processes of given natural resources together with the possibility of measuring these different physical quantities by using a same unit of measure.

objective of this section is rather that of hopefully contributing to better understand the social impacts and the problems generated by the interpretation of given social dynamics in terms of the physical laws verified by scientists within their laboratories. Analogies and similitudes populating discourses whereby scientists interpret and explain their intellectual advancements often obscure the fundamental difference existing between laboratories and everyday life and the perverse effects that can be generated when this difference is neglected by experts and policy makers asked to intervene over societies. It is for this reason that a good part of this chapter is dedicated to discuss how this difference can be kept hidden and to describe the specific social dynamics, whereby the myth of the actual presence of an ontological entity named energy is kept alive when persons and societies are seen as kind of engines and the perverted outcomes of this mindset are not recognized.

When analysed in relation to its social impacts, energy comes to represent a very particular type of abstraction together with a handful of other conceptual artefacts produced by science. Strange as it may seem, the main peculiarity of this concept and some of its present and most relevant social impacts can be highlighted by studying a roundtrip that this concept has started during the nineteenth century. This roundtrip has brought energy from the vernacular to the laboratories of physicists and engineers and has taken this concept back to everyday life under the guise of a *metaphor* that is *constantly* being taken *literally*. Put it bluntly, the result of this roundtrip is an aberration that consists in assuming that when we, e.g. say "Mr. Smith is a Lion" we constantly and completely overlap and identify the person of Mr. Smith with a Lion, as if we would constantly be under the influence of a kind of tribal ritual where Mr. Smith plays the Lion or as we would constantly feel as we felt when we were children and acted the part of a Lion in the game of the Savanna wild animals with other children transforming themselves into as many wild animals.[6] In these ritual transformations the Lion becomes so magnified to completely blur and overcome Mr. Smith's identity in the interactions we have with him, as if we would forget about the context where Mr. Smith is not a Lion, or as if we would lose the capability to distinguish the context where Mr. Smith lives his everyday life from the context and the intercourses where the statement "Mr. Smith is a Lion" actually holds. In this situation, the Lion (and not Mr. Smith) is the authority defining and controlling how we have to interact with it.

Because of the peculiar relationship existing between things of everyday life and concepts developed within laboratories and because of its roundtrip between these two worlds, it can be assumed that *energy* is transmogrifying ourselves and our environment as the Lion of the example has overlaid and reduced Mr. Smith's unique identity and the potentially infinite types of different intercourses and

[6]It may be interesting to observe that the disability consisting in not being able to distinguish among different contexts is associated with schizophrenia (see Bateson et al. 1956). It has then to be pointed out that the example and the considerations presented here result from a specific way of intending metaphors, myths and rituals. Put it shortly, metaphors are seen as small myths telling a story that is embodied by people through a ritual. This interpretation of metaphors, myths and rituals can be found, e.g. in Vico (1744), *La Scienza Nuova.*

interaction contexts that it is potentially possible to establish with him. One of the main enacting "ritual ceremonies" whereby this is happening worldwide has very likely been set-up during the nineteenth century when a specific ritual has started developing around the metaphor "Labour is Energy". This is most probably the central metaphor whereby the energy concept has irradiated over Western societies and has transformed and reorganized *labour* and most of human activities organized around this concept according to conservation and degradation principles. Through this central metaphor most of the social settings, skills and artefacts that people had previously developed to provide for their necessities through labour started (and still are) being transmogrified to generate *work*[7] according to laws and principles defined in laboratories for the energy concept. The tracks of this transformation are for example reflected in the highly intensified commodification of labour and in the wide diffusion of labour theories of value that could take place with the progressive assimilation of labour to the abstract notion of energy as defined and employed by physicists and engineers starting from the mid-nineteenth century. On the material side, these tracks can be found in the impressive diffusion of technologies generating work from natural resources according to precise conversion factors and in all the sequences of human activities organized around these technologies since that time. These sequences of activities have, among others, played the role of ritual actions and ceremonies whereby the literal interpretation of the above-mentioned metaphor has been constantly validated and the distinction between humans and motors has been progressively obscured.[8] The validation of the literal interpretation of the energy metaphor does not, however, exclusively come from activities organized around motors and steam engines. As it can be inferred, for example from Mirowski (1989) this validation is actually the result of a mutual reinforcement and validation process involving metaphors of motion produced by physicists, metaphors of value produced by economists and metaphors of body produced by biologists. Put in other words, the constantly literal interpretation of the energy metaphor has to be seen as the result of the joint and mutually reinforcing social constructions of invariants and conservation principles taking place in the fields of physics, biology and economics. As pointed out by Mirowski (1989), the structures of explanation produced in these three different fields have probably always been homeomorphic and would legitimize each other even in the face of possible disconfirming evidences produced in each field. Labour theories of value reflected

[7]The word "work" is being used here to refer to a motor/machine like conception of the organization of productive activities that prevailed after the invention of the energy concept. The word "labour" is instead used to refer to a pre-existing conception of the human activities whereby goods and services were provided within economies. The decision to use these two words to denote these two radically different ways of intending human activities is not accidental. Compared to work, labour denotes indeed a type of activity where the body of persons and their physical effort is more directly involved and needed. A similar distinction is also present in French (travail vs. oeuvre), Italian (travaglio vs. lavoro), German (Geburtswehen vs. Arbeit).

[8]For an historical account concerning how this identification between human and motors has developed, see Rabinbach (1992).

perfectly this interconnection and mutual reinforcement at least one century before the advent of complex systems could suggest that the information flows developing within biological organisms and ecosystems could be identified with those occurring within monetary systems and human made energy distribution networks.[9] An homeomorphism and mutual reinforcement between metaphors related to conservation and variation principles applied in economics, biology and physics would have been at work well before the formal analogy among the dynamics of money, information and energy flows within complex systems could be established. According to Mirowski (1989), this mutual confirmation of metaphors was indeed already operating when the institution of money was disconnected from any reference to a particular commodity and became the abstract representation of pure value, when the dual concepts of the organism and of natural selection were established within the evolution theory of Darwin and when the energy conservation and degradation principles were established by physicists and engineers around the mid-nineteenth century.

Besides this mutual legitimization occurring among metaphors produced in different areas, further elements to understand the social construction occurred around of the literal interpretation of the energy metaphor have to be found in the studies conducted by Ivan Illich and Uwe Poerksen in relation to the evolution of some terms used by science.[10] These studies allow inferring that the previously described transformations could not have been possible without a roundtrip undertaken by the word "energy" itself. This round trip started in the vernacular where energy was used to refer to "the vigor of an utterance, the force of an expression, the quality of a personal presence",[11] at least until the sixteenth century. It continued then through the laboratories of physicists and engineers where energy was associated during consecutive phases with a magnitude remaining constant during collisions of rolling balls and springs oscillations, with a primordial entity obeying conservation and degradation principles, with states of electromagnetic fields, with field symmetries, with time homogeneity. It is through these metamorphoses that energy has become more and more esoteric and distant from what can be experienced. At the same time, however, physicists have made energy come back to common speech by popularizing the supposed *real nature* of the various conceptual artefacts they have progressively associated with this word and by supporting their theses through the material artefacts that were being massively constructed by referring to the energy concept. The account provided by Illich and Poerksen explains how this roundtrip has caused a colonization of the vernacular by an abstract concept whose precise meaning cannot be discerned anymore and that, contrary to other abstractions generated within languages and practices, makes impossible that people can use it with precision by adapting it to the different

[9]For an explanation concerning how this identification is realized, see for example Goerner et al. (2015).

[10]See Illich (1983) and Poerksen (1995).

[11]Illich (1983).

contexts of their everyday life.[12] The following sections of this chapter will discuss some of the consequences of this roundtrip and how the intensive technological and economic development that has accompanied it have led to the creation of energy metaphors which are constantly being interpreted literally and which are transforming people into consumers of a phantom entity.

As several concepts and ideas have been already introduced in the brief reasoning so far presented, it is however probably better to pause a bit and provide some more element to hopefully make it clearer.

First, it may be worth highlighting that the metaphors being considered are not just a mere figure of speech and the elements involved in the considered social dynamics are not merely linguistic. These metaphors represent indeed small myths telling a story that is validated through specific ritual actions. In the example of the metaphor "Mr. Smith is a Lion" it is assumed, for example that this small story is being actually lived by Mr. Smith and/or is being told by a speaker who has actual had interactions with Mr. Smith. Similarly, the metaphor "labour is energy" is not a simple figure of speech. It is deeply interwoven with energy technologies and is validated and kept alive by other central metaphors produced by biology and economics and by all the sequences of actions that since the mid-nineteenth century are being widely generated and undertaken around engines and that may lead to organize people activities as if they were motors consuming the conserved and degradable entity whose properties have been established by physicists and engineers in their laboratories. Human actions and practices are, therefore, assumed to have primary role for the generation, validation and maintenance of these types of metaphor.

Second, despite the metaphor of Mr. Smith and the Lion initially used as an example is of a different type, the metaphors and the ritual actions of interest in this chapter are always made by one term (e.g. energy) that refers to a concept and the related operational definition produced by science by rigorously applying the scientific method, whilst the other term (e.g. labour) refers to a series of embodied interactions with the physical world experienced by people during their everyday life and is assumed to be progressively identified with the term representing the abstract concept defined by science through the previously described process of literalization. Behind these specific types of metaphor there is hence, on the one hand, an abstract scientific conceptual artefact which one term of the metaphor refers to and, on the other hand, the object of a variegated and personal experience

[12]For further information concerning how energy and other abstractions undertaking a similar roundtrip can be characterized and distinguished by the abstractions generated within common languages see (Poerksen 1995). Before describing 30 criteria allowing characterizing a series of science abstractions like energy, Uwe Poersken explains how they differ from other abstractions, like e.g. the concept of "love" as used within common parlance. He explains how the meaning of the word "love" can be expanded to embrace a wide range of meanings (from affection within families, to physical love, to pleasure at a piece of music, to the love of humanity, etc.) allowing the speaker to employ it in a series of different ways depending on the context where it is used. The word energy does not instead allow the speaker to define it. It disempowers the speaker, it cannot be replaced by pantomime or gesture, it is like a lego block that can be put everywhere within speech, its meaning is not affected by the context where it is used, etc.

made by people which has socially coalesced into the word constituting the other term. The two words constituting the metaphors studied here have, therefore, a completely different nature and history. One word (e.g. the word "labour" in the example above) still keeps track of a variety of meanings that allowed the speaker to use it very precisely to denote very different situations and practices, the other (e.g. the word "energy") results instead extremely impoverished in content because of the roundtrip and reshuffling operated by science. As first highlighted by Uwe Poersken, this latter type of words generally disempowers the speaker, creates the need for expert help, leads to silence, cannot be represented by gesture or pantomime, is not affected by the context where it is used, etc.[13]

Third, the above considerations and the way in which human labour has been progressively aligned and organized according to energy conservation and degradation principles, while all the different meanings and practices associated with the word labour have been progressively reduced to and identified with an activity produced by an engine, are assumed to represent a specific case of the following general perverse effect of applications of scientific artefacts: the extensive use of technologies developed around an abstract concept of science can serve and be used to constantly and extensively validate the literal interpretation of an associated metaphor. In this way, this concept can function as a kind of black hole attracting into its orbit and causing the progressive disappearing of myriads of alternative practices while the different meanings coalesced into one term of the metaphor and denoting these practices progressively disappear and are drained into the void generated by the term used to connote this scientific concept. This void is due to the fact that this scientific concept has typically no analogous in everyday life and the term used to connote it has, therefore, a mere symbolic value.

Fourth, together with the extensive technical applications they can contribute to develop, scientists and experts producing the above mentioned abstractions can contribute to validate the literal interpretation of the above mentioned metaphors by popularizing the real nature of these abstractions. Curiously, however, these abstractions may be object of continuous redefinitions by scientists and experts themselves; as happened, for example in case of energy. Despite the abstract conceptual and material artefacts developed by scientists belong to a world which is definitely separated from everyday life, these scientists and laboratories have however not to be considered as living within kind of case glasses keeping them separated from the real world. They are clearly and constantly influenced by the cultural milieu, where they live and their artefacts have to be considered as the result of a particular type of social construction.[14] The separation existing between

[13]See explanations provided in the previous footnote.

[14]It is a particular social construction because, contrary to other concepts and categories developed by societies, the possibility of an involvement of common people during the construction and validation of these conceptual artefacts remains very limited. Despite this limited involvement, these latter conceptual artefacts can remain in use within common language due to the indirect validation they can receive from scientists and from technological applications employed on a large scale.

the world of their conceptual artefacts and the world where people usually live is mainly determined by the fact that the scientific method whereby these artefacts are produced imposes that their properties must hold everywhere, for everybody and at any time. The specificity of all the particular cases that can be identified during everyday life escapes by definition the reductions operated to produce the abstractions of science. This is generally why the properties of these abstractions can be observed only under the very controlled and specific conditions created within laboratories.[15]

Fifth, the reasoning being presented implies that energy is engaging all the members of societies into a constantly literal interpretation of a central metaphor. It might be objected that many persons cannot actually be engaged in this literal interpretation because they do not have a proper cognition of what energy is in so far as, for example, they do not know the difference between energy (kWh) and power (kW) or they do not know-how the associated conservation principle is defined. The point, however, is that the knowledge of the physical properties of energy and of the related units of measure is not a necessary condition for engagement. The simple physical involvement in the ritual actions represented by the sequence of actions they undertake around existing technologies together with the fact that societies and experts validate the assumption that these technologies and the social aggregates constituted around them function like engines consuming energy inputs is alone sufficient for engagement. On the other hand, it might be objected that energy does not engage in any metaphor at all, because it is a real entity of which people can have direct and physical experience; for example when they receive an electric shock or when their body is heated by solar radiation. The answer to this objection is that the direct experience of these transformation processes does not certainly allow per se to infer the presence of a universally conserved and continuously degraded entity that has been named energy by scientists and whose existence is nowadays questioned by the scientists themselves.

Sixth, the aberration being described in this chapter does not relate to the presence of the metaphors being discussed. It rather concerns their *constant* literal interpretation and the social constraints impeding that a metaphorical character can be associated with some abstractions generated by science. Rather than as the result of a social construction, these abstractions are in fact presented and interpreted as always existed natural entities that have been detected by science. The energy concept is, for example extremely useful in so far as it used to study specific

[15]Science is axiomatically rooted on abstractions supposed to hold anywhere, at any time and (in principle) for anybody because of the irrevocable application of the principle of repeatability and reproducibility of observed events that must be observed by the scientific method. Due to the strict observance of this principle, science cannot typically tell or suggest anything in relation to how explain particular and unique events. Relationships with single and unique entities can be explained by science only by referring to qualities that are shared with other entities, i.e. by neglecting what makes these entities unique. On the temporal side, not repeatable events occurring in a specific instant are considered by science either as never happened or (in case they produce durable and detectable changes) are considered as the result of pure “chance”.

transformation processes of matter and radiation and to design, manage and construct technologies relying on these processes. This concept should, however, be considered a "reality" only within a specific technical and scientific environment. When energy is instead constantly interpreted as a real entity populating everyday life, the survival of any person and biological being become subordinated to it, energy considerations can become one of the main driver of political decisions concerning how people should organize their lives, the extensive usage of technologies supplying energy becomes automatically legitimized and our dependence on them is reinforced. When, on the contrary, they can be seen as a metaphor, the installation of energy technologies can be subordinated to the political decisions concerning plenty of alternative practices that people can design and implement to provide for their necessities. It should not be very difficult, for example to realize how the number and the diversity of solutions that can be identified and implemented to solve a number of issues change dramatically depending on whether people are seen as energy consumers or as active persons endowed with the practical knowledge needed to provide for their necessities. How labour activities can be organized in a city in such a way that the highest possible number of person in a city can receive profit from these activities to enjoy their lives? How houses and buildings in a city should be rebuilt or retrofitted, which of them can instead be left how they are in order to allow a comfortable way of life to everybody without increasing the burden on the available natural and economic resource budget? Which transformation processes of available resources is better to implement to provide for the necessities of people living in a city? How might people's transit be organized to make it more sustainable and less stressful? Answers to these question provided by mindsets identifying cities and persons with a kind of energy motor will be very likely informed by principles of measurability, efficiency that can be applied everywhere and that would necessarily increase homogenization[16] and dependence on specific technologies, whilst mindsets recognizing the metaphorical nature of energy will more likely consider all the specificities of the situation at stake and will potentially be able to generate a much wider variety of context specific answers which have nothing to do with energy consumption. The solutions generated in this way will nevertheless generally have important energy impacts and will be identified by starting from considerations related to what people do and say in relation to their lives. Needless to point out that possible solutions elaborated under the former mindset can be implemented mostly by technicians and experts, whilst the knowledge concerning the specific practices that can be implemented in a specific context can reside within all people living in this context and this people can therefore play a fundamental and much more active role in their design and implementation.

[16]Homogenization is seen here as the somehow inevitable outcome of the application of solutions based on an identification with energy motors and informed by measurability and efficiency principles.

Most of the issues above mentioned would certainly require much more detailed discussion and actually concern a variety of scientific abstractions developed in conjunction with widely employed technologies. They concern, e.g. abstractions and operative definitions that have been produced by scientists for *time*, *space*, *speed*,[17] etc., and how these abstractions have been applied in relation to a large series of human activities and practices related, for example to time management, urban planning and mobility, buildings design, etc.

All of these concepts and applications would deserve a specific "metaphorical" study because they are having deep impacts on how sustainability issues are currently framed by researchers and policy makers. The following section will nevertheless refer the above considerations to a further key scientific concept that is closely connected to the energy concept and that has determined a radical shift of paradigm in how social practices are conceived and organized since the mid of the past century: *information*.

Information Metaphors

Computers represent the main central metaphor whereby we have been taken in the present age of complex systems. The current social imaginary concerning the nature of the world around us and the way we interact with it is deeply shaped by computer technologies and is progressively changing us into *multitaskers* while the universe is being interpreted as a bits processor.[18] The main abstraction whereby we are brought into the world of this metaphor is *information*. As happened with energy, information has undertaken a round trip started from everyday life during the second decade of the twentieth century when it still had several meanings and could take additional ones depending on how it was used in a context. At that time, its three basic meanings were generally related to *instruction* (in the domain of education), *inquiry*, *investigation* (in jurisprudence) and *message, report, evaluation* (probably in the area of institutional assignments).[19] It then happened that it reached the laboratories of cyberneticians and biologists around the mid-twentieth century and was subsequently taken back to everyday life extremely impoverished in content as an abstract entity that can be measured through probabilities.[20] This

[17]Scientific developments concerning the notion of *time* and related social implications are closely interwoven with those of the energy concept. For information on this point see, for example Perulli (1996). Some considerations on how the social construction of energy and the social transformations that led to conceive time as a resource implicate each other are provided also in the first chapter of this book. Concerning the notion of *speed*, Illich et al. (1996) provide important elements to perform the proposed study. Concerning the notion of space, Bauman (1998) can instead represent a good starting point.

[18]On this point see, for example Chiribella et al. (2011).

[19]See Poerksen (1995), p. 38.

[20]See the first chapter of this book for further explanations.

roundtrip has brought societies within the rituals animated by a relatively new phantom-named information.

In the light of what was mentioned so far, it is not so bizarre to assume that the nature and the impacts of the transformations induced by these rituals can be grasped by studying the elements of the central metaphor that can be identified by looking at how information has been defined by cybernetics.

Cyberneticians tell us that "information is a difference which makes a difference".[21] It can probably be stated that by redefining information in this way, cybernetics has led to the technical implementation of the latest vision of "change"[22] provided by science. This is the metaphor that deserves to be studied to understand the central ritual in which people are collectively engaged by complex systems.[23] To do so, it is necessary to try to grasp the nature of this particular type of information and how it has been modifying the way in which we interpret change and the role of persons within it.

The anthropologist Gregory Bateson has contributed to this end in important ways and has, among others, provided a series of fascinating examples taken from the phylogenesis of biological organisms, from the phenomenology of perception, from linguistics, from sociology, etc., whereby this transformation can be understood. Gregory Bateson has explained how meaning and information content would be purely *relational* and constitute an infinite series of hierarchically organized contexts.[24] According to Bateson, this type of information regulates the functioning and the evolution of all natural aggregates involving living entities. Through this type of information, any entity of the natural world comes ultimately to be defined and regulated by infinite chains of relationships (i.e. differences) with other entities. In the world made of the information created by cyberneticians, there are no objects with proper and intrinsic characteristics. There are only relationships. Starting from the smallest elementary bricks constituting any natural object up to the largest aggregates available in nature, we only find dualities, i.e. relationships between two irreducible entities, which are non-entities when taken alone.[25] Natural objects would appear just when artificial delimitations are created within complex systems by defining an "inside" and an "outside". The descriptions of complex systems

[21]See for example Bateson (1972) and what discussed in the first chapter of this book for further details.

[22]Change can indeed be considered as a "difference which makes a difference".

[23]People can somehow be considered as collectively engaged in a ritual when their habitual actions are informed by given central ideas. The rituals constituted by complex systems are generated through the actions accomplished by using the technologies whereby these systems are being socially constructed (e.g. computer technologies) and are informed by the central ideas whereby these technologies are conceived, used and imagined.

[24]See the first chapter of this book for further information.

[25]This specific property of information relates also to how sequences of 0s and 1s come to constitute computer programs. 0 and 1 are indeed the two non-entities defined by their mutual relationship that can be used to represent any kind of elementary difference starting from which complex and hierarchical organized pieces of computer codes can be produced.

dynamics that can be provided in this way (i.e. a description in terms of delimited entities and related functions within an external environment) are assumed to result just from a decision/intervention by an *observer*.

It is for this reason that complex systems actually engage people into a ritual aiming at associating objects populating everyday life and their related functions with the entities populating an underworld made of the information bits that constitute the complex systems which these objects are supposed to belong to and that regulate the evolution of these systems. It is through this ritual that change is being reinterpreted. With complex systems, the "classical" explanation of change formulated by evolutionary theory and relying on a combination of variation (due to stochastic processes) and selection is indeed somehow assumed to belong to an outside world created by the observer. These two explanatory principles are being revised by complex systems theorists by interpreting *observed* stochastic variations as the result of thermodynamic processes generated by energy and matter flows occurring within a kind of underworld and obeying phenomenological principles that can be equivalently described and interpreted through information theory and thermodynamics.[26]

Nevertheless, besides this underworld made of matter and energy flows where information and energy metaphors are mutually validated, an upper world made of functions supposed to evolve and adapt continues to remain. Our attention has hence to focus at the microscopic interface existing between these two worlds in order to understand the ritual in which we are engaged by taking literally the information metaphor associated with complex systems. It is indeed at this interface that functions performed and observed during everyday life are being identified with the abstract information that can be managed by computers and that can be possibly associated with underlying energy and matter flows.

It has indeed to be stressed that functions observed in natural entities are being artificially jointed to bits of information and, thanks to information, to energy and matter flows. As already mentioned in the first chapter of this book, the establishment of these joints in any department of knowledge and human practice is what essentially characterize the present age of complex systems. These joints are being

[26]Variations appearing in the world of the observer are supposed to be generated by dynamics studied by science addressing far from equilibrium open systems. Put is shortly, these dynamics are described in terms of structures (i.e. structured/not random patterns of energy and matter flows) emerging through the dissipation of energy gradients. It is as if steep gradients applied to open systems would give open systems "a certain tension that creates a condition of an accident waiting to happen" (see Allen et al. (2003), p. 331. Thinking of a fluid within a box and of the convection currents generated through it because of a temperature difference applied at the two opposite extremities of the box may help to visualize what being described here). This accident generates then a kind of cascade through positive feedback loops whereby structures of energy and matter flows are created. These energy and matter flows would then tend to dissipate the previously mentioned applied gradient. The creation of these energy and matter flows can be equivalently described and studied by information theory in terms of probabilities and creation of information. It is through the establishment of this equivalence between probabilities and energy and matter flows that information theory can incorporate and confirm thermodynamics (for a detailed account of how this incorporation takes place see, for example, Ulanowicz (1997), pp. 63–71).

established, for example in ecology and energy studies when each observed function reproduced by biological entities is associated with the consumption of given amounts of energy and matter, or within biological studies when it is pretended that molecular biology (studying life with a thermodynamic/informational posture) and organismal biology (studying life in terms of evolution and adaptation of functions) can be merged, or when computerized prostheses are created to enable people to perform given functions through the elaboration of information, or when personal time is managed by prioritizing and allocating given amounts of measured time units to each daily activity. Present information technologies allow performing these allocation tasks at such level of detail that the constructed joints often appear as the reproduction or the detection of something established by nature itself. Unfortunately, however, they always generate or are generated through a *discretization* and a reduction to *standardized* functions of the continuous spectrum of unique functions that human beings and nature can generate[27].

This discretization and standardization is the sign of the artificial character of an underworld made of energy and matter flows supposed to generate functions reproduced within complex systems. This underworld comes indeed to represent an artificial layer that is interposed between people and what people see and do in the material world. Its energy and matter flows come to constitute a kind of artificial membrane impeding a direct and fleshy coupling with this world and impeding to generate an infinite variety of functions while interacting with it. The constant literal interpretation associated with the information metaphor consists in accepting the constant presence of this artificial membrane constituted by a cybernetic version of information (and by the associated energy and matter flows). It consists in considering this membrane as a natural entity and in accepting the limitations[28] determined by its interposition in the interactions that we have with the world.

[27]As discussed in the first chapter of this book, this *discretization* and *standardization* can be seen as the result of an (at least partly) arbitrary resolution of an otherwise unsolvable allocation problem. This problem inevitably arises whenever the amount of resources (e.g. energy, time, matter, etc.) consumed by a given organism or person to perform given functions has to be established. The solutions that can be found to this problem are inevitably associated with a discretization and standardization of these functions. Complex systems somehow always invite to take decisions in relation to these types of unsolvable allocation problems and make people blind to the distortions they generate in this way.

[28]Limitations may relate to the types of explanations that can be provided by referring to dynamics occurring within this membrane when studying natural and social phenomena. As far as the reproduction of human functions is concerned, it has to be stressed that the creation of the artificial prosthesis represented by this membrane through suitable interfaces and information technologies can clearly highly potentiate a number of single and specific human functions. We daily experience this by using computer technologies to purchase goods, write letters, communicate with friends and colleagues, etc. The limitations being discussed relate mostly to the isolation from the external world generated by this membrane and to the variety and the character of the functions that is possible to reproduce thereby. The kind of limitation effect on human functions being described resembles in some respects to the effects produced by a magnifying lens. While magnifying single and particular details, this lens inhibits indeed the vision of all the details allowing constructing the whole picture of the object being observed.

What has been highlighted so far in relation to the influence exerted by energy and information metaphors seems to be the inevitable consequence of the following general social phenomenon concerning science and technologies: when technologies commonly employed by people become the object of intense scientific reflection, they become able to *speak* and to convey messages on the large scale that societies end-up accepting as certainties. They tell very convincingly what specific human activities are and what are some of the specific processes that constitute the world around us. This has happened, for example, when mechanical sciences generated around human tools during the twelfth century have led to conceive the world and the beings populating it as constituents of a gigantic clock or, as previously discussed, when energy physics generated around engines during the nineteenth century led to conceive people and the whole universe as motors, or with the developments occurred within cybernetics and biology with information theory and information technologies during the past century.[29] Due to the intensive and large scale employment of the technologies conveying them, the power of these messages can become so strong as to generate a social blindness in relation to how they actually cause distortions within societies while legitimizing extensive processes of homogenisation determining the disappearance of a large series of discourses and practices which are typically specific of the cultural context where they are generated and which better fit it. These dynamics are extremely reinforced by the fact that the metaphorical nature of the abstract concepts whereby the functioning of technologies is explained remains hidden and people do not realize, for example, that abstractions like energy and information do not actually belong to their everyday life. These abstractions can certainly serve to engineers and technicians to build extremely useful technologies. Given the way in which they are developed and used, they should however be seen as belonging to just one specific sphere of everyday life and become subordinated to the myriad of concrete processes and solutions people can actively develop to comfortably provide for their necessities. The social factors impeding the recognition of the metaphorical nature of the above mentioned abstractions are ultimately the same factors impeding to recognize what makes people fundamentally different from motors and information processors. They pave the way to a colonization by technologies and impede to identify some perverted implications of this colonization that will be further analysed in a subsequent section of this chapter. Before doing that, it is necessary to further discuss how metaphors come to play a fundamental role in social organizations and how they and the material artefacts whereby they are kept alive can inhibit the exertion of a specific human capability contributing to constitute the vital force of any social aggregate.

[29]These transformations have been discussed under Chap. 1 of this book.

The Role of Practical Knowledge and the Effects of Its Inhibition Within Social Organizations

Metaphors are the fundamental and necessary element of any scientific advancement[30] and play a central role in the social construction of concepts and principles constituting languages, rules, material artefacts, institutional settings and know-how whereby societies can be organized.[31] Their relevance for social organization is the consequence of the funding role played by a particular type of *complementarity* within human affairs.

Emotional and rational, analogical and logical, unconscious and conscious, profane and sacred, particular and general, feminine and masculine are useful couples of adjectives that can serve to connote and characterize the two polarities of this particular dual structure. Out of the two polarities, the former is usually more primary (i.e., it pre-exists to the latter) and generates the latter whilst constantly embedding it. The former polarity is more closely associated with human bodies, senses and feelings of persons, whereas the latter may be seen as a result of a social process of abstraction, objectification, hypostatization. The way in which this generation takes places can be described archetypically by referring to the myth of *Eros* and *Psyche* (Neumann 1971).

The generative power and the primacy to be acknowledged to the first polarity are a consequence of the fact that the human body and perception are the necessary precondition for the social production of any kind of abstraction (either this abstraction is represented by the terms constituting a given language, or by a concept, a rule, a principle, or an institution) whose meaning can be communicated among people and can represent a point around which individual persons coalesce in a social aggregate without generating violence on some of its members. In order to perform this aggregation function, this abstraction has indeed to be generated by the body and to remain embodied in all the individuals constituting a society. The meaning of words, rules, concepts or ideas used to organize a social aggregate has to be felt by the flesh of all of its members. These abstractions could not be maintained and used without violence within societies if they were not embodied, and the evidence of this embodiment is that the concepts generated in this way can always be referred and adapted by people to the context and the particular circumstances where they are used.

Based on the above, it can be concluded that the type of *complementarity* to be maintained between the previously mentioned two poles relates to the process whereby one pole is generated from the other and can be returned to the other. This kind of process is always bent over and submitted to the primacy of the particular. It results from possibility of exerting the human habit that Aristotle (Nicomachean Ethics 6.8) named *Prudentia or Phronesis* (i.e., the wisdom of prudence and practical thought) and that allows being guided from and adapting general rules to

[30]On this point see, for example MacCormac (1976).

[31]On this point see, for example Lakoff and Johnson (1980).

the particular case when producing good actions. This habit involves primarily human senses, not reason. It requires a kind of opening to the possibility of being constantly surprised by the disclosing of unexpected developments and the capacity to cope with them by taking own perception and feelings as ultimate guide.[32] The exertion of this habit corresponds to the exertion of a practical knowledge described also in (Heidegger 1994) and it can be probably assumed that practical knowledge acts within a kind of infinitely recursive cycle: it is what initially allows people properly generating general rules and abstractions from the particular and then allows taking the general rules back to the particular case and the particular case to the general rules during the circumstances of everyday life.

Nevertheless, it has also to be observed that, despite their original union, the two polarities at stake in this process constitute two separate and completely different worlds governed by radically different rules and principles. The two worlds where the two aforementioned polarities live are completely separated and disjointed. Given this radical separation, the inhabitants of one out of the two worlds can indeed be described in the language of the inhabitants of the other world only by using metaphors. Given this otherworldliness, the only reasonable statements that can be produced about the former inhabitants by the latter inhabitants are statements like "Mr. Smith is a Lion" with Mr. Smith and the Lion respectively belonging to each of these two radically different worlds. The fundamental role played by practical knowledge derives from this unescapable separation. Practical knowledge can indeed be seen as a kind of boat connecting the shores of these two worlds.[33]

[32]It may be interesting to observe that the capabilities required for the exertion of this habit are the same that Aristotle attributed to artisans. While advancing with their works, artisans are indeed supposed to be able to adapt the ideas they have in their minds to the specificities and particularities unexpectedly emerging within the matter and the materials being used. The ultimate guide for the making of their activity is not reason, but perception (see Mitcham (1994), p. 122; Carl Mitcham produces this description of artisans' activity based on what reported in *Nicomachean Ethics* 2.9.1109b23; cf. 2.2.1104a1-9). Same capabilities were considered also essential for politicians. Politics was indeed assumed to be concerned with action and deliberation about particulars. Grounding in law was assumed to be necessary, but law alone could not serve to do justice. Judges, for example had certainly to be educated by the law, but they were also supposed to perfect and complete it while applying it. Judges and politicians were in this respect the functional equivalent of artisans (see Mitcham (1994), p. 125; Carl Mitcham produces this description of politicians and judges based on what reported in *Nicomachean Ethics* 3.3, 10.9 and in *Politics*, 2.8.1269a10).

[33]This particular role of practical knowledge can probably be verified also within human languages. It can indeed be probably assumed that practical knowledge allows converting own feelings and sensations into utterances that can be understood by others and allows interpreting utterances produced by others by converting them into own feelings and sensations. A noun or a sentence can after all be considered as one part of a metaphor, the other part being constituted by the feelings and the sensations of the speaker pronouncing it. The exertion of practical knowledge for understanding languages could then be identified with the act of interpretation as performed by the listener during the process whereby he understands the words pronounced by a speaker and connects in this way to the speaker's internal world. Due to the way in which science can attach particular operative meanings to some words, the above mentioned process can be inhibited (see, what mentioned in subsequent parts of this section).

As long as generated metaphors are not taken literally, it can be assumed that the realization of this connection entails the same capabilities at stake with hermeneutical *interpretation* (i.e., the exertion of practical knowledge entails the same capabilities and involvement at stake when performing texts translations, interpretation of historic events, etc.). Interpretation brings foreign worlds under the interpreter's spatial and temporal perspective. Interpretation implies that foreign worlds are brought within the context of the interpreter (i.e., it automatically brings foreign worlds within the geographical and historical space where the interpreter lives). Interpreters are (or should be) always within an "as if" condition, i.e. they are (or should be) aware that their interpretations consist in the construction of metaphors and that these metaphors should not be taken *literally*. The two worlds bridged by their interpretations should never be considered as strictly equal: they are analogous. This characterization of the role of practical knowledge indicates the kind of awareness to be cultivated in relation to abstractions and concepts used within societies and provides important insights concerning a particularly relevant type of perversion which often passes unnoticed.

The previously mentioned generation process may indeed be perverted and the primacy of the first polarity may be disregarded. Societies can be organized based on the properties of abstract concepts like the ones described in the previous sections and made completely dependent on the dynamics associated with the supply of energy units, information bits or monetary units by allowing that the technologies validating the existence of these entities take the radical monopoly of most human activities. This phenomenon is completely similar to what happens on a smaller scale to some social practices in those places where, for example you "cannot move any longer without wheels, you cannot eat without a refrigerator, or you choke unless you do not turn on the air conditioner"[34] and people's lives become completely subordinated to the abstract dynamics that can be generated by car mobility, food refrigeration and artificial cooling of living environments. Although extremely useful, technologies can in some cases completely redefine, reduce and homogenize the meaning of human practices linked, e.g., to transit, to eating or to human comfort by taking the radical monopoly of these practices and by obliging people to live according to the dynamics of the abstract concepts whereby they are conceived. In case of energy and information, the exertion of this type of radical monopoly is much more than a mere possibility due to the literal interpretation and mutual reinforcement of associated metaphors occurring within competitive market settings and to the diffuse presence of technologies validating this interpretation. People's lives are nowadays completely dependent on the dynamics generated by the joint evolution of aggregated energy demand and supply within existing energy markets. In a similar way, they are made more and more dependent on the various large scale information flows and decision systems

[34]These examples have been taken from Illich (1983).

wherein people, machines and the environment are increasingly integrated.[35] There is indeed a very close formal similitude and mutual reinforcement among the dynamics exhibited by energy, information and monetary flows due to the way in which energy, information and money have come to constitute complex systems by becoming the ultimate resource units that have to be consumed and exchanged to perform any kind of human activity.[36] The type of dependence that has been nowadays established on existing financial markets offers indeed another fundamental evidence of the abstractness of the rules regulating these artificial complex systems, of how these rules can be highly disembodying and generally correspond to a blind and passive submission to myths and assumptions of very different nature which are not anchored in what persons can feel and practically make and verify.

The consequences of this submission are, however, anything but immaterial. Their degree of materiality is the same of the immense technological apparatus and the huge amount of natural resources supplying the standardized energy and information units whereby most of us live today. Their origins have to be ultimately found in the impossibility of putting the dynamics related to the consumption of these artificial units under some type of social control, this impossibility being due to the fact that every action we accomplish is nowadays mediated by this consumption.

Despite the possible best intentions of people submitting to their dynamics, the complex systems so created become actual and autonomous delegates of the administration and regulation of human violence and desires. This is basically what happens when the metaphors whereby these systems are created are constantly taken literally and, due to a social blindness and misplaced concreteness, societies are made increasingly dependent on technologies validating this interpretation. As idols, they may tend to dis-embed[37] from any type of social control. The occurrence

[35]These information flows may concern, e.g. the elaboration of risk profiles based on the continuous monitoring of socio-technical systems and related feedback loops needed to timely respond to emerging threats (wars, nuclear accidents, environmental accidents, etc.), or management systems for transport networks used within large cities and regions, or the elaboration of consumers profiles whereby investment decisions are taken by companies, or the monitoring of the GDP of national economies, etc.

[36]See the first chapter of this book for further information. Important insights concerning the mutual reinforcement taking place among the energy, information and money metaphors can be found in Mirowski (1989).

[37]This idea of dis-embeddedness has been taken from (Polanyi 1944). Polanyi argues that the large scale application of the international gold standard and the transformation of land, labour and money into fictitious commodities that can be sold within a market regulated by Adam Smith's "invisible hand" has been at the root of the upheavals and violent disorders that took place in the North Atlantic Community and its periphery at the beginning of the twentieth century and has led to the World War I and the subsequent Great Depression. According to Polanyi these disorders would be the consequence of a "double movement" of long duration made of the expanding application of the above mentioned abstractions on the one hand and of the spontaneous resistance to the pressure they generate within civil societies on the other hand. As suggested by other scholars, in this chapter it is being assumed that this double movement of long duration can be generated also in other social spheres where scientific abstractions are largely applied (e.g. within social arrangements established to regulate energy and natural resource consumption).

of these situations of dis-embedding can most probably be considered as the result of the inhibition of people's practical knowledge and the impossibility to generate the associated virtuous hermeneutical cycle whereby persons can improve their present and future conditions.

Counterproductivity of Technological Myths

The social phenomena so far described can be analysed in more detail by taking the studies performed by Ivan Illich,[38] Jean-Pierre Dupuy, and Jean Robert[39] as a starting point. To the knowledge of the author of this chapter, these phenomena have been so far investigated only by these scholars and mostly in relation to *instrumental* artefacts, i.e. in relation to artefacts industrially conceived as means to allow any person to achieve a specific end (e.g., cars, medicines, but also institutions like schools and hospitals in so far as these entities can be seen as instruments conceived to allow people mobility, allow solving specific health problems or achieving conditions of equality through education). Given their seminal influence on the ideas presented in the previous sections and the light they can help shed on the previously described dynamics associated with energy and information technologies, the outcomes of these studies will be briefly summarized hereunder.

The above mentioned scholars performed their researches during the 1970s, when the social attention was intensely focused on the impacts of the industrial production on the environment and on the availability of natural resources. During that time, they decided to direct their attention to how an intensive production of given technological instruments could turn these instruments into the *main obstacle* to the achievement of the ends for which they had been conceived by causing an overall decrease in the number of persons able to reach these ends. They were interested in a type of instrumental counterproductivity which had nothing to do with negative environmental impacts or reduced marginal returns of investments on given technologies. This type of counterproductivity rather concerned the dynamics whereby, e.g. cars can become the main obstacle to people's mobility, medicines and hospitals can become a cause of iatrogenic diseases or schools can become a social threat for learning capabilities of people. Thanks to their studies, these scholars managed to identify three different and interwoven social dynamics contributing to this type of counterproductivity that were respectively named *technical*, *social* and *cultural* counterproductivity.

The *technical* counterproductivity is basically generated by overlooked and unwanted impacts of technological instruments on the *systems* where they are massively put in circulation. These impacts generally consist in the creation of situation of overcrowding and obstruction or are generated by the presence of

[38]See Illich (1976).

[39]See Dupuy and Robert (1976), p. 55.

interconnections and correlations existing among parts of these systems which are overlooked for various reasons when instruments and the possible infrastructures needed for their employment are fabricated and used. These situations may occur, for example, whenever too many vehicles are put in circulation within a road network, or when too many graduated students are produced by a scholastic institution in specific disciplines compared to existing demand in related job sectors, or when the extensive and prolonged use of specific medicines produces side effects which are worse than the diseases to be cured for the organisms wherein they are injected, or when the way in which an hospitalization system is established or managed generates an unexpected circulation and exchange of diseases among patients, etc.

The *social* counterproductivity associated with the intensive production of technological instruments is instead due to a confusion similar to that usually arising between stock and flux variables that leads to mistake these instruments for human capabilities. This confusion would lead to erroneously identify existing possibilities to express personal capabilities (concerning for example how we manage to move, how our bodies manage to keep themselves in good health conditions, how we learn, or how we establish relationships with other persons and the environment) with the presence of given instruments (e.g., cars, hospitals, medicines, schools, telephones, etc.) and would cause the intensive technological multiplication of the latter. Instruments would indeed allow developing personal capabilities in the targeted areas only up to a given threshold value achieved by the intensity of their industrial reproduction. Whenever this threshold is exceeded, instruments would markedly constrain and limit the development of these capabilities by causing people to prefer receiving or buying things rather than doing things by themselves. This situation increases, among other, the chances that a condition of technical counterproductivity is achieved.[40]

Finally, the *cultural* counterproductivity concerns directly myths and metaphors accompanying the extensive use of instruments. As already explained in the previous sections, due to the way in which they are conceived and produced, the extensive use of instruments would automatically put them at the centre of rituals, mythopoetic ceremonies and social liturgies generating existing certainties concerning human action and extinguishing the added value that persons can give to their design, fabrication and employment. It is in this way that for example cars would become able to convey a specific and standardized message concerning what has to be intended for mobility, refrigerators would tell with the authority of science what food conservation is, air conditioners would define what has to be meant by comfort, etc.

[40]The presence of these critical thresholds has been subsequently questioned by the same scholars who hypothesized their presence. This probably happened when they acknowledged that the achievement of given ends can be socially delegated to different instruments. Besides schools, the task of educating people has been, for example socially delegated also to TV programmes, the Internet, etc.. This possibility probably renders the concept of counterproductivity threshold practically inapplicable.

These three factors comprised the main conclusion of the above mentioned scholars in a time when instruments were probably still the main human artefact informing the current ideas about human action and related social and environmental impacts.

The situation was however already radically changed in the age of complex systems we were already entering when these scholars were conducting the above mentioned studies.[41]

Complex systems are indeed made of single types of often highly interdependent artefacts whereby an increasing number of different functions can be performed by people thanks to flows of abstract and standardized units of information, energy, matter, money, time, etc. This characteristic radically changes the social dynamics whereby situations of counterproductivity can be generated.

Nowadays, the extensive use of monitoring and information processing technologies associated with these systems can for example contribute to solve major problems linked to the technical counterproductivity that was generated by instruments. This can be done by redirecting, rearranging, and rescheduling the production of their outputs or by avoiding unwanted instruments outputs interactions in a way that looks very similar to what can be done by modern GPS systems to solve potential situations of traffic congestion or by internet based monitoring systems to prevent the outbreak of dangerous epidemics, natural disasters, or accidents.

Situations of *technical* counterproductivity do not nevertheless disappear with complex systems. Rather than to single ends achieved by given instruments, these situations relate nowadays to how complex systems and persons integrated therein may become the main obstacle to the achievement of the only comprehensive end these systems can allow achieving, this end being represented by systems survival through expansion, i.e. through increased complexity. This counterproductive situation is generated specifically by the way in which existing complex systems rely on the flow of highly standardized resource units and tend to become a single global system made of tightly interconnected parts to increase their chances of survival. Small perturbations originating into one part of the system may indeed become constantly able to generate kinds of avalanches whose effects quickly propagate throughout the whole system causing a deep restructuring and putting system survival at risk.

The *social* counterproductivity of instruments is also deeply reshaped by complex systems. Contrary to instruments, the artificial prostheses integrating people into complex systems mediate any kind of action and cannot therefore be abandoned. The inhibition of personal capabilities caused by an existing confusion between the possibility of expressing these capabilities and the presence of given artefacts that characterized instrumental social counterproductivity cannot therefore be a problem anymore. This problem is completely overcome due to the fact that persons are *de facto* constantly integrated into specific types of artefact for any type

[41]For a description of this transition see the first chapter of this book.

of action they accomplish. With complex systems, the expression of personal capabilities may at most relate to *informed decision making* concerning the possible consequences of a predetermined finite number of decision options that can be taken within these systems. Either people have to decide whether eating pasta is better than eating vegetables for their metabolism, or they have to decide which of the products available in their supermarkets is less harmful for the environment, or they are asked to take decisions concerning their life and death by medical geneticists,[42] or they have to manage private companies, states budgets or ecosystems, the various involved complex systems always frame the so-called informed decision making process in terms of a choice among a series of pre-established evolution patterns to be made based on the knowledge of given risk probabilities. The possibility of expressing personal capabilities and autonomy is in this way reconfigured in terms of decisions to be taken within a kind of poker game where players can know in advance the probabilities of the outcome of their choices. The social counterproductivity of decision systems framed in this way has to be found in how they inhibit any kind of personal initiative by limiting it to a selection among different choices that could be performed also by a computer. At the same time, these decision systems can make persons blind in relation to the hypotheses whereby probabilistic scenarios are elaborated and to how these hypotheses could be put into question by how people can reconfigure their habits to face the problems at stake. Probabilities create the illusion that the statistical categories defined for their calculation are something real that can deterministically influence the evolution of the specific case at stake. On the other hand, complex systems constantly provide evidences concerning the impossibility of predicting the evolution of associated dynamics neither by using probabilistic nor deterministic methods.[43]

The confusion existing between stocks and flux variables that had characterized the instrumental *social* counterproductivity does not result any longer from a confusion between personal capabilities and the presence of given material artefacts. With complex systems this confusion moves and relates to each of the single units of information, energy, money, time, etc. assumed to flow within these systems. Their definition creates indeed the illusion that these units represent actual and stable entities, whilst information and the probabilities whereby it is calculated remain an abstract difference between non-entities, energy is a variation that only materializes during transformations, the value represented by money is an abstract estimate produced around exchange processes, time units are assumed to measure a pure flow, etc.

Complex systems reshape finally also the *cultural* counterproductivity of instruments, in so far as the metaphors animated by these systems change. Rather than being related to what single instrument types tell to people concerning their activities, these metaphors relate altogether to the abstract resource units flowing within the complex systems that people and their material artefacts have started constituting.

[42]On this point see for example Samerski (2002).

[43]On this point see, for example, Taleb (2001).

It is amazing to think of how their literal interpretation can serve to legitimize a complete reorganization of societies and how the constant integration into the artificial membrane created by complex systems implies the inhibition of any form of control. The association of any activity performed by people with the combined consumption of abstract units of information, energy, money, etc. is alone sufficient to render the complex of these units scarce in so far as their flow obey a conservation principle implying that they cannot be generated at will from nothing and the abstractness of these units put people at the dependence of the technologies and experts that can supply them. This scarcity is at the same time responsible for a continuous intensification of production activities and for continuous efforts to make this production more efficient.[44] Rather than to reduce the overall

[44]The interplay of conservation principles artificially established for different abstract resource types is crucial for the generation of this situation of scarcity and the associated social dynamics combining increased resource efficiency and increased consumption. The following imaginary story may perhaps help clarify this point. Let us assume that on our planet there is still a land whose inhabitants are not aware of the fact that whatever action they accomplish requires the consumption of some units of energy, time, information or money. Let's then assume that one person of this land decides to move, e.g. to New York City, London, or Rome. Once arrived in one of these cities, the first thing he learns is probably that he cannot do anything without some amount of money and that he is not allowed to get this money *for free*. The second thing he learns is that he has to work to get this money and that this means that during each day he will have to spend given amounts of time while producing something that can be valued and rewarded with the money he needs. Unfortunately, however, the amounts of time he can spend each day are *limited* and this will oblige him to divide his time into a part that can be used to get money and a part that can be used to spend this money and do what he wants to do. In addition, most of the things he could do while working, or during his leisure or while at home, necessarily require the utilization of complex devices consuming units of energy (that, overall, is available in *limited* amounts and cannot be got for *free* either) because these devices can do in less time what he or other persons could do and people cannot spend too much of their time while producing what they want, otherwise the time remaining to use it will be too few. The third thing he might probably have to learn is that he has to be trained and receive the necessary information to properly use the previously mentioned machines, to be able to work, to get money and to be finally able to do what he wants to do. Unfortunately, these information cannot be get for *free* either. If he is lucky, it might be allowed to download this information from the internet. He might even manage to work and get money and the things he wants through the internet. The information and the things he gets through the internet however also require money, energy and other types of resources units. Overall, he would then learn that he must find a way to maximize the amounts of money, energy, time, information and other indispensable resource units he receives or employs because his survival and well-being depend on them. This, however, will require that he has to be very efficient while using these resource units, because these resources, when taken individually or all together, are necessarily scarce. The anxiogenic condition described in this very simplified and imaginary account could not certainly be referable to all persons living in the cities taken as an example. Some of them might have important amounts of the previously mentioned resources and manage to escape this condition. There might even be entire cities and nations depending on these resources where all the inhabitants could manage to escape this condition. The above mentioned conservation principles imply, however, that situations of particular abundance in one part of the system where these principles are enforced determine situations of exacerbated scarcity in another. The previously mentioned dynamics have indeed to be referred to the whole system, the system at stake being probably already represented by our whole planet.

consumption, these efforts, however, generally serve to destine what saved to other end-uses within a process of continuous consumption growth.[45]

As also showed by the examples produced in the first chapter of this book, the nature of these dynamics typically transcend the possibility that people can intervene to change them. With complex systems we are always within a bigger context that determines how things will ultimately go. Somehow, complex systems make any responsible action impossible. Besides the previously mentioned causation mechanisms associated with variation and selection, complex systems entail a type of causation that reminds a kind of Aristotelian *causa finalis* by which we are guided and to which we cannot nevertheless give sense. Its effects are indeed intrinsically unpredictable. Within complex systems we are invited to live within an oxymoron. We have to prepare for and learn to manage the unpredictable. The adjectives used to describe what complex systems call for are: resilient, flexible, adaptable, etc.

Escaping Energy and Information Myths

As repeatedly pointed out, metaphors play a central role within languages, rules, material artefacts, institutional settings, and know-how that organize societies. They allow connecting the subjective experience and feelings of persons with the general and abstract concepts and rules whereby people can form social aggregates. They can be considered as small stories and myths that people can embody through repeated actions necessarily mediated by given material artefacts. This embodiment could not however take place if these metaphors were not generated by referring to entities that people can experience during everyday life and if people could not report and adapt these stories to their personal experience through their practical knowledge. Practical knowledge is indeed another fundamental element whereby societies are established. This faculty can be seen as a human characteristics allowing people to enter (or create) and exit (or adapt) the metaphors, myths and rituals they create to administer societies. Practical knowledge somehow represents the possibility that, as persons, we are *socially* given either: (1) to produce and rigidly stick to the cultural constraints represented by concepts and rules established within societies, or (2) to modify and adapt these constraints to our specific situation by taking our body and our feelings as ultimate guide. The proposed view sees practical knowledge as the manifestation of a kind of vital and grounded force that animates and complements while remaining irreducible to any rational account of its functioning. If the type of flexibility associated with the exertion of this human faculty could not be expressed within a society, this society would soon or later become violent or generate violent reactions by its members. Persons and their

[45]On this point see, for example Jarvis et al. (2015).

specific situations come indeed before any abstract rule that can be established to administer a society.

As previously mentioned, the exertion of the human faculty associated with practical knowledge can, nevertheless, be inhibited whenever people constantly live within a myth, i.e., whenever the metaphors underlying this myth are constantly taken *literally*. Considering that this is what probably happens in case of the energy and information metaphors validated by current complex systems, the question then is whether it is possible to stop taking these metaphors literally and understand in this way the social implications of their literal interpretation. It is indeed through this change of posture that the influence of these metaphors can be taken to the foreground and alternatives to the technological practices validating them can be found. By taking the first metaphor used in this chapter as an example, it can be stated that the main route to stop taking a metaphor literally consists in managing to enter an observation perspective wherefrom this metaphor can become a *similitude* and an "as if" can hence be added in front of the statement "Mr. Smith is a Lion". By doing so, we automatically put ourselves in a different context, we put ourselves outside and take distance from the world of the metaphor. In this way we become able to observe Mr. Smith under a perspective that allows identifying in which respect Mr. Smith is different from a Lion and in which sense he can be assimilated with a Lion. Put in other words, the possible close similitude between Mr. Smith and the Lion notwithstanding, we must become able to *speak* about Mr. Smith whilst *not* speaking about the Lion. When we manage to speak of a metaphor in terms of an "as if", this is the sign that we are performing an act of *interpretation and translation*; we are exiting the world of the metaphor and we are taking Mr. Smith into our world, into the place and the time where we are staying. This means that, in order to exit a metaphor that is being taken literally, it is necessary to take either a spatial or a temporal distance from the place where the metaphor is being lived. In case of energy, this means that we have either to attempt to move back to the past in a time when this metaphor did not hold and societies were not organized according to energy principles, or to move to a possible still existing social context where people are not organized according to energy principles. There is, however, also a third and very interesting possibility. Given the categories used within the proposed account, this third approach can be called *profanation*[46] *of energy*. To profane energy means to bring the materials, the technical apparatus, the institutional settings and the technical skills out of the "sacred" world where liturgies and rituals around energy are administered by experts and give them back to the profane life of ordinary people. This is probably the most practical approach to experience the *exiting* and understand the implications of living *within* the energy metaphor. The more the administration of so-called energy resources, of related technologies and technical skills are left to the management of ordinary people, the more it can

[46]The description of the proposed approach in terms of a *profanation* has been derived from a series of considerations on how persons should relate themselves with technological artefacts as formulated in (Agamben 2009).

become possible to observe the flourishing of a diversity of practices whereby people can provide for their necessities by using natural resources without becoming energy addicted and causing an unnecessary depletion of these resources. The decision to call it "practical" approach is not accidental, as this approach corresponds to the possibility of developing and exerting the type of practical knowledge previously described.

The same type of considerations applies to the information metaphor and the value metaphor validated by current monetary systems. As previously mentioned, the literal interpretation of energy, information, and value metaphors reinforce each other within existing complex systems. These metaphors keep people within a separate sphere from where it becomes more and more difficult to exit. As pointed out by Jeremy Rifkin,[47] in an age that has been consecrated to information, people receive some comfort by believing that their efforts to generate and exchange larger amounts of information allow them to increase their autonomy and organization and that, as for natural evolution, they can strengthen in this way all their social relationships thanks to the increase of their interactions and of systems complexity. Nevertheless, the general loss of the sense of agency caused by the integration in these systems is nowadays common experience and the progressive integration into dynamics that escape any form of personal and social control takes with it the impossibility of experiencing and appealing to any sense of citizenship and responsibility. The case of renewable energy systems can represent one extremely relevant case of mutual reinforcement among the energy, information and value metaphors generating these complex dynamics. Modern information technologies allow nowadays to manage huge numbers of abstract energy units generated from extremely diffused natural sources and to distribute them within suitable energy distribution networks. The association of a monetary value with these units and their commercialisation within competitive market settings is rightly seen as the most promising approach to promote their extensive employment and reduce dependence on non-renewable energy sources and relative negative environmental impacts. The adoption on a larger and larger scale of this type of approach requires, however, an increased delegation to information technologies of the activities linked to production, transmission, distribution and end-use of energy sources together with a process of technologically managed adaptation to the discontinuities and variabilities in the supply of energy associated with the complex dynamics generated by these systems. Beside reducing harmful emissions, policy strategies reproducing this type of approach are destined to inevitably increase social dependence on complex systems dynamics and to contribute to constantly validate the literal interpretation of associated metaphors while causing a large scale homogenization in energy end-uses mostly due to the need of synchronizing energy demand to an energy supply that can unpredictably fluctuate during time. On the other hand, these strategies are completely blind to how people can develop context specific practices to temporarily and comfortably live disconnected from the energy

[47]See Rifkin (1998).

network and outside the energy metaphors. The consequences of this constant embedment in the literal interpretation of given central metaphors are relevant not only for our environment. They are relevant in particular for how they can negate to people the possibility of making direct experience of the world around them and to elaborate own solutions for the problems affecting their lives. The effects of this imprisonment within metaphors validating our constant dependence on the supply of energy and information units are completely similar to those generated by the marketisation of every aspect of our lives. The association of a monetary value with every dimension and activity of our daily life is transforming any place and social aggregate into a kind of museum and showcase where people cannot any longer make a direct and lively experience of the things around them. It is amazing to observe how this type of marketisation is changing cities (e.g. Venice, Florence and, in general, other cities declared Intangible Cultural Heritage of Humanity by UNESCO), regions (e.g. natural parks or oases) all over the world into museums where things and spaces are exhibited for consumption without allowing any actual experience of use and habitation.[48] The creation of these "sacred" spaces that people cannot profane by making any real experience of use or habitation is not an exclusive characteristic of capitalism and associated monetary systems. It corresponds to the previously described inhibition of practical knowledge that can be generally ascribed to specific types of technologies and, more in general, also to energy and information technologies. The curious thing is, however, that the main entities responsible for this inhibition are not the specific material instantiations whereby these metaphors are produced. Cars can, for example be substituted by bicycles without changing the metaphor according to which "transportation is the act of moving people from point A to point B in a given amount of time". The literal application of this metaphor within cities is alone sufficient to provoke radical modifications in the landscapes and to drastically limit the infinite ways of transit that can be adopted by people within these landscapes by expressing their practical knowledge. This metaphor does so by projecting all the possible conceivable ways of transit along the common metrics of travelled kilometers/hour either cars, or bicycles, or trains, or airplanes are used to move people. The same may happen, for example, when gas boilers and gasoline cars are substituted by heat pumps and vehicles consuming PVs' electricity. The production and the employment of these two different material arrangements can be animated by a same energy metaphor that can become the ultimate and main constraint shaping the way in which people address the issue of heating and transit. The different practices that people can develop to provide for their heating and transit are in this way generally subordinated to standard technical solutions that can be provided by experts of various kind.

This being said, it perhaps has to be stressed that technologies and associated metaphors are extremely necessary and useful. It is however also extremely necessary that they can be put among parentheses and subordinated to people

[48]These examples have been taken from Agamben (2007).

decisions. To do so, they have to be somehow read in transparency. They have to be kept at sufficient distance in order to become hopefully able to see how they are framing and constraining our ways of life. At the same time, however, they have to be read from the inside. We have to listen to the stories they tell us and we have to take them very seriously. These metaphors are extremely powerful. They speak to us and confirm themselves through an immense technical apparatus.

Conclusions and Policy Implications

Energy and information technologies can nowadays allow translating any human, mechanic and biological activity into extremely abstract flows of information, energy and matter units.

The evolution of any aggregate at any scale (from the smallest organisms populating an aquatic environment to the households living in a city, from the traffic congestions occurring in a road network to the winds circulating in the stratosphere) can be translated into flows of this kind and be monitored in the smallest detail.

While changing beings populating societies and ecosystems into intricate streams of abstract entities that can be managed and monitored by computers, these translations are also at the core of continuous and large scale reorganizations of the processes whereby people arrange their lives. The benefits that these processes and transformations can generate to the environment and to societies are huge.

The complex networks generated by energy and information technologies can in principle integrate on the large scale and up to the microscopic level any aspect of human and biological life. The possibility of associating a monetary value with the artificial units circulating within these networks creates incredible business opportunities which are increased by the fact that the links of these networks can be bidirectional and allow any of its nodes to manage and inject additional units into the networks. The classical distinction existing between producers and consumers of economic goods can be cancelled in this way. Persons integrated into these complex networks become goods prosumers whose activity is subordinated to the possibility of having access to the information, energy and matter flow circulating therein. With a computer and a 3D printer, persons seem to have become able to fabricate, use or sell whatever they want. Through suitable application service providers, people can transform their cars into a taxi, their houses into a hotel and their kitchens into restaurants where human and material flows can be redirected. At the same time, energy renewable technologies and computer technologies are assumed to enable everybody to provide for their own energy needs while selling extra energy units within complex distribution networks regulated by suitable market rules. The transformative power associated with energy and information technologies is enormous, and the fascination these technologies have on people, policy makers and corporate organizations is impressive.

It should however be taken into due account that the complex systems these technologies constitute can very easily disengage from any form of social control

while generating artificial dynamics of consumption growth which can also have extremely negative and large scale impacts on persons and natural resources.

The thesis supported in this chapter is that a fundamental social factor contributing to the creation of these perverse dynamics has to be found in the huge process of homogenization and reification resulting from the fact that societies are identified with motors and information processors that, together with the energy and information resources whereby they function, play nowadays the role of central metaphors that are constantly taken literally The literal interpretations of these metaphors reinforce each other within present competitive market settings while being constantly validated by the huge technological apparatus whereby complex systems are being socially constructed. These interpretations shape our imaginary and inform the way communities organize becoming responsible for an increased dependency on abstract resources units and reinforcing growth in natural resources consumption.

This being said, it has however to be stressed that metaphors are necessary constituents of any social aggregate. Languages, rules and institutional settings established within societies rely typically on metaphors which contribute to structure personal feelings while connecting these feelings to abstract concepts around which social aggregates can coalesce. Nevertheless, what differentiates the energy and information metaphors validated by present complex systems is that they engage people into a literal interpretation that is practically impossible to escape and report to a personal experience.

In a time when we are constantly assimilated to computers and are invited to manage our lives and the environment as multitaskers working under a regime of resources scarcity, it becomes extremely difficult to explain how these metaphors can cause the extinction of a variety of sustainable practices while inhibiting the possibility of making actual experiences of use and habitation. The situation is then worsened by the fact that the problems caused by their literal interpretation cannot be identified even by scientists and experts asked to solve these problems. Their methods and the way they operate is indeed typically the result of this literal interpretation and represent therefore part of the problem. In a time when existing complex financial systems are escaping the control of national economies while increasingly generating situations of extreme poverty, professional managers mostly formulate solutions supposed to allow increasing monetary flows through increased monetary investments. In a time when working systems are expelling an increasing number of people inhibiting any possibility that they can provide for their necessities and actively contribute to the wellbeing of their societies, people and opinion leaders mostly just require that these systems provide more work, without discussing whether the output of this work is actually needed. In a time when fossil fuels have proved harmful for people and the environment, experts and scientists mostly point to a massive substitution with renewable energy sources and to the implementation of energy and material recycling systems that can hopefully guarantee a continuous growth in the power output of economies, without considering that this continuous growth is in itself a major sustainability problem.

These approaches are certainly important, but can serve to solve the problems at stake only to a very limited extent.

Possible way outs to this social entrapment so far described can only be found by acknowledging the axiomatic incompatibility of social organizations to the reductions operated by scientists (including economists) and the fundamental value of people's practical knowledge in the definition of solutions to increase their well-being and the sustainability of their ways of life. As mentioned at the beginning of this chapter, it is not a question of denying the extreme usefulness of the technical solutions provided by science. It is rather a question of subordinating their application to people's necessities and to the solutions they can develop through what they know and what they can experience about their context. This change of perspective requires that policy making re-gains a particular sensibility allowing that the implementation of abstract solutions is always subordinated to the specific needs of the specific context. Whilst this change of perspective is in principle easy to achieve under a theoretical point of view, it remains extremely difficult to implement in practical terms. It needs that, rather than just inputs, the outputs of human activities are also discussed and negotiated. In so far as policy solutions are informed by energy and information metaphors, they are mostly limited to technical solutions that can be implemented to reduce energy and material inputs or harmful impacts of these inputs. These solutions are, however, ultimately functional to continuous growth in resources consumption and, above all, somehow represent a way to bypass true political and democratic discussions concerning outputs. Technicalities concerning their design and implementation typically leads to the exclusion of people's contribution to their enforcement in very devious ways. People are typically just involved as passive consumers supposed to change their individual behaviour. The decision-making processes are in these cases mostly informed by individual and atomised considerations concerning investments needed by individuals and collectives to implement given technological solutions.

When sustainability issues are instead faced by taking an economy's outputs as a starting point, the problems at stake can in principle more easily become genuinely political. Energy and information metaphors can be put between parentheses and people can in principle stop taking them constantly literally. The nature of the policies that can be implemented to increase sustainability can also change radically in this way. When adopting the proposed perspective, it can be easily acknowledged that the variety of policy options that can be considered to increase sustainability increases dramatically. Decisions concerning, e.g. where and how to build a school or how to allow children reaching it that are taken by having the outputs of these activities as main focus, enable the implementation of plenty of context dependent solutions reducing the amount of inputs needed. Decisions taken within school institutions concerning, e.g. how to improve learning capabilities of people enable to envisage solutions not exclusively relying on the consumption of natural resources (like those related to the usage of computers, books, etc.). When, instead these decisions are taken by starting from the inputs, the related outputs result somehow implicitly frozen. They cannot either be changed or re-discussed, either because the presence of these outputs is erroneously considered as the

expression of a not constrainable people's free will, or because a possible re-discussion of outputs is seen as potentially detrimental for the existing economic system. In addition, the implementation of most technological solutions aiming at reducing inputs is typically promoted to be replicated in the highest possible number of sites because of the economic interests of involved actors, this situation typically implying that this implementation can become counterproductive in several cases (e.g. is it really necessary that all houses, cars and other technical equipment are replaced by more efficient substitutes when some of them are very rarely used by their owners? Rather than pretending substituting gasoline cars with electric vehicles in every circumstance, could not it be better complementing this approach with an approach focused on the reduction of the needs for vehicles? In which circumstances specific human practices can be preferred to automated solutions for the provision of comfort within buildings?). For the way in which the energy and information metaphors have originated, there is always a close connection between energy, information and monetary considerations impeding that the need for given outputs and the possibility to increase well-being by reducing these outputs can be actually discussed. Objects and activities around us seem to be destined to be immediately transmogrified and converted into an associated energy, information and monetary content regulating their reproduction and impeding that they can be manipulated and adapted by people according to their will. This process of mutual reinforcement among energy, information and monetary metaphors is exemplary in the case of the ongoing transition to renewable energies occurring in several countries. Without computer technologies this transition could not have been even hypothesized. Through these technologies, it becomes possible to hypothesize that energy produced from highly distributed renewable energy sources can be managed and redirected to provide the energy inputs needed by whole cities and countries. Monetary values associated with the units of energy generated from renewables and managed through computer technologies are then supposed to provide the main leverage for this transition. The artificial dynamics of growth that can be generated in this way and the way in which they can dis-embed from any form of political control are probably considered by policy makers as a minor thing compared to the environmental and economic benefits expected from them. These general economic and environmental benefits often lead to neglect the risks generated by the progressive complexification and homogenization of the energy supply system (mostly oriented to supply electricity) associated with this transition. In addition, the need to promote the development of alternative practices that people may adopt to survive to the anything but infrequent system crashes that can be expected in this transition do not seem to be object of major concern. It is instead not so unrealistic to assume that the actual accomplishment of this transition depends on the possibilities that societies will be given to develop ways of life allowing them to temporarily and comfortably survive while disconnected from current energy, information and monetary systems. This condition of temporary disconnection would be enabled by the huge variety of context dependent solutions that people may elaborate to increase their well-being while reducing their dependence on these complex systems by relying on their practical knowledge.

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