1 Exiting the multiple crises through 'green' growth?[1]

Elmar Altvater and Margot Geiger

The disembeddedness of the market economy from society and nature has resulted in the market becoming independent of society on the one side, and has created an inherent constraint on the other. This is described in Karl Polanyi's classic '*The Great Transformation*,' about the capitalist market economy since the second half of the eighteenth century, after the industrial revolution (Polanyi 2001 [1944]). At present, this inherent but external constraint is more precisely defined as a constraint to permanent growth. But what is economic growth? Economic growth is measured as the increase in gross domestic product (GDP), although there is considerable scepticism about the meaningfulness of this indicator. This has triggered in recent years a debate about growth, zero growth, post-growth and degrowth, sustainability, prosperity and happiness. The economy grows when the volume of labour increases and when more natural resources (including territorial space) are used for an increase of GDP and for spatial expansion. Consequently, growth is more of the same, an *extensive* parameter.

Growth also occurs when the productivity of labour increases. This is generally only possible when 'living' labour is replaced by 'dead' capital, and mostly supplemented by it. This applies to machinery and buildings, and is especially the case for spatial infrastructure that is 'built environment' or a 'spatial fix'. It is especially important when the energy of human labour and the energy from animal or plant biomass, as well as energy from wind and water to propel mills, is replaced by fossil energy.[2] The energy density of fossil fuels is very high and they can be used anywhere because they are easily transportable. Fossil fuels can also be used at any time, day or night, winter or summer. Radiation energy from the sun does not have these properties: no wonder that a new age, the industrial age, began with the use of fossil fuels. Growth now becomes an *intensive* parameter; increasing productivity occurs through a substitution process. The use of fossil energy instead of biotic energy enables an acceleration of all economic processes, a compression of time.

Economic growth has proceeded in a cyclical manner since the beginning of the industrial age. Only in the 'golden years' of economic development from about 1950 to the mid-1970s did steady, crisis-free growth appear to be the rule, at least in the industrialised countries. However, this was an erroneous assumption. Growth does not exclude crises. The systemic crisis from 1929 onwards was no singular event: it is repeated in the twenty-first century. It is a historic rupture that affects all dimensions of the capitalist system. This destructive financial crisis affects the entire economy, is expanded into a currency crisis, unsettles the global hegemonic order and then alters the global political situation. Since it is at the same time a crisis in energy supply, a climate crisis and a food crisis affecting billions of people, this multiple crisis questions the moral values on which social coexistence and cohesion is based: thus, it is a systemic crisis.

In the following, we will focus on the growth dilemma between the constraint towards surplus production and the limits set by nature. We start with a brief description of this constraint, and how it contributes to an overloading of society and nature and has propelled the financial system and the 'real' economy into crisis. Following on from this, the dimensions of the multiple crises and the regulation of the use of time and space will be discussed, in order to understand the challenges and assess the consequences that will occur when fossil fuels run out and need to be replaced by renewable solar energy. How must time and space be regulated when biomass is not only harvested for food but to shift productivity and secure mobility? Hence, what conflicts will result from rivalry in land use?

Excessive financial claims in the systemic crisis

The financial and economic crisis, together with the crises in climate, food supply and politics, has taken on a magnitude in the second decade of the twenty-first century that surpasses the great world economic crisis of 80 years ago. The causal connection between the crises is difficult to discern and to clarify (see Altvater 2010). Basically, financial crises occur when financial claims by creditors in the form of documented securities cannot be serviced from income flows or the assets of the debtors. Either the financial claims are too high or the real surplus of the creditors (macroeconomically, i.e. the real economic growth rates) is insufficient, or both occur together. Thus, the crisis is never just a financial crisis, even when it starts off as such, because the value of securities, which is based on shrinking returns, suddenly drops.

Instead, the crisis is a crisis of real capital accumulation and has two sides. One is the value side and the other is the use-value side. The latter is doubly characterised, on the one hand by the natural limits of availability of those energy sources, matter and living beings, whose use-value can be transformed in order to satisfy human needs. Up to a few decades ago, their limits seemed so far away in the future that it was assumed that they could be ignored. In the meantime, they have moved threateningly close to the evolutionary 'tipping points' (see Rockström *et al.* 2009). On the other hand, there are also social limits concerning human needs and the manner of managing private and public goods. The growth rates of surpluses in the real economy (i.e. profits on invested capital and growth rates of gross domestic product (GDP)) tend to decrease.

The decrease in GDP growth rates throughout the world is indisputable, even though this decrease is not occurring evenly or simultaneously. The profit rate falls when the distributive relation between profits and salaries and wages does not change, and capital intensity increases. This explains why economic policy efforts to overcome the crisis shift the income distribution, to the detriment of labour and in favour of capital, and at the same time reduce the capital coefficient (the capital expenditure per unit of the social product). The reaction to the deceleration in growth reverses it: the income on capital rises and is invested, increasing growth and consumption of resources. If capital is used for speculation, indirect effects are likely to increase surplus production and resource consumption to service financial claims. This is a kind of 'rebound effect' caused by crisis. Due to the crisis, the consumption of energy and matter has been reduced, but the economic policy measures undertaken to overcome the crisis result in growing consumption of energy and matter, comparable to the 'rebound effect' described by William S. Jevons in 1865 (Jevons 1865; Santarius 2012): The use of resources increases when their market prices sink because of productivity increases or – the case mentioned here – when economic policy stimulates capitalist growth.

The returns of the financial world increase in any case, in contrast to the real economy surpluses and their growth rates – until there is a financial crash. First, the financial market returns will compete upwards. Financial places are attractive when they offer comparatively high returns. Second, the financial markets are so decoupled from the real world that social or natural limits to increasing returns disappear from the horizon of financial actors. This is an effect of the disembeddedness mentioned above: financial innovations particularly serve to financialise everything by securitisation so that virtually everything can be traded on liberalised markets worldwide. The legal and institutional prerequisites were created in the time since the 'neoliberal counter-revolution' (Milton Friedman 1970) in the 1970s.

The high returns result from trading in securities and create the illusion that value is created by the 'origination' of these securities. Their value is not realised by work and thus by transforming nature, but is derived from the returns that are obtained by trading assets on the financial markets. If the returns decrease, then the value of the securities decreases, and the credit relation collapses when these serve as security for other loans. The great financial crisis breaks out if this happens *en masse* instead of in individual cases. Capital is fictitious, and in a crash its value turns out to be an illusion. The real capital circulation is also disrupted. The seemingly endless sequence of buying and selling goods just stops: value and surplus value cannot be realised as profit on the market. Growth decreases and develops into a recession when it is negative. The financial and economic crises, together with the political crisis, are different aspects of a capitalist systemic crisis, which appears as a sequence of crises in time and space.

Several stages can be discerned in the course of the financial crises since the 1970s. The debt crisis encompassed the 'third world' in the early 1980s. The overture was provided by Mexico's insolvency in August 1982, followed by the drum roll in Brazil in November of the same year. This crisis was more than an economic and financial crisis: it was a global historical turning point. First, it was generated by the recycling of petrodollars and was directly linked to the fossil energy crisis and its regulation. Second, it changed the global power positions of the oil-producing countries of the Middle East, of the Latin American countries and also, to a lesser extent, of the African and Asian countries. Hence, the crisis had a geo-economic and geo-political dimension. Third, the financial innovations that were developed were precisely those without which the spectacular dynamics of the global financial markets and the current financial crisis would not have been possible. Fourth, neoliberal ideology was promoted in this phase of upheaval. Milton Friedman (1970) calls it a 'counter-revolution', directed against the Keynesian policy concepts of the previous decades. This was essentially a declaration of war against state intervention in the free market. Now the anti-interventionist position rules in the universities, in the media, in the corridors of politics and in conference centres: free trade provides prosperity and any intervention in free trade operations diminishes prosperity.[3]

The monetarist doctrine of price stability was used to discipline wage earners and their unions. Increasing unemployment made it easier to bring militant workers under control. The increase in real interest rates since 1979 did indeed reduce inflation in Western industrial countries, but it reduced investment at the same time. The profit rates again increased after their sharp drop in the 1970s (see Brenner 2006), but were insufficient to compete with rising returns on financial assets (Deutscher Bundestag 2002, especially pp. 69ff.). The position of creditors, i.e. the large internationally operating banks and funds, was strengthened by the high rates of interest, and the foundation was laid for a financial wealth-based regime of capital growth. The debt burden also rose with increasing interest rates. This exceeded the debtors' ability to pay and caused the aforementioned debt crisis.

The oil-exporting countries had to find investment opportunities for their petrodollars after the oil price shock of 1973 (see the extensive presentation by Clark 2005). But, where? The industrial countries were not attractive, since these were in an economic crisis from the mid-1970s. In this situation, the US banking system offered to recycle the petrodollars from the 'oil and sand states' at the Persian Gulf to the emerging markets of the developing countries, and simultaneously to rectify capital shortage as well as energy shortage. The US government and international organisations such as the International Monetary Fund (IMF) and the World Bank supported the 'recycling' of petrodollars through the expanding international financial markets.

Thus, oil income was still invoiced in US dollars and mostly invested in the US banking system. The banks used the dollar accounts for extensive credit supply to developing countries. Under the protective shield of the US military, this business chain supplied the oil producers with currency income, weapons and military and political security. The 'oil and sand states', as they were disparagingly called, changed with time into 'dollar, oil and tank states'. The US could maintain its oil supplies after its 'peak oil', the peak of oil production in the USA, which can be dated to the beginning of the 1970s (see Deffeyes 2005), and at the same time establish the US dollar as the oil currency. The third-world countries received access to credit, which they used to cover their energy needs, but also to finance the luxury consumption of the ruling elite, the armament of the military dictators of those decades and – as in Brazil – to finance 'pharaonic large-scale projects'. In other words, they had to incur debt, but predominantly with the US banking system, in US dollars and not with the oil exporters. That became disastrous for them when the USA raised the interest rate on dollar debts to combat inflation, to finance the double deficit in the balance of payments and the national budget. At the same time, the USA tried to offer the US dollar as a 'value anchor', as a secure reserve and asset currency to the financial markets. The US dollar, weak in the 1970s, emerged stronger out of the 1980s debt crisis in which all indebted states were embroiled. The energy crisis, the dollar crisis and the crisis of political hegemony were overcome at one blow, and the US-dominated world order was reinforced following several years of dollar devaluation and the country's ignominious defeat in Vietnam in 1975.

As recently as in the course of the current financial crisis, the 'American Century', as it was called after this extraordinary performance, faced a downturn. The present financial crisis started in 2007/2008 as the 'subprime crisis' of bad mortgages in the USA. The earnings of mortgage holders were not sufficient to service the interest dues, which increased from about 2006 onwards, following a very low interest rate regime after September 11, 2001. The mortgages were bundled into complex financial instruments, with the approval of the rating agencies, and sold all around the world. Suddenly, billions, even trillions of assets were bad and 'toxic', also nearly all over the world. They depressed bank balances as valueless assets that had to be depreciated. Often the banks overextended their capital requirement. The 'subprime crisis' of the 'NINJAs' (no income, no job or assets) in the US suburbs – the problem of mortgage holders without income, job or assets – turned into a global bank crisis.

Since the affected banks were classified as 'relevant to the system' (mostly according to the simple formula 'too big to fail'), governments immediately stepped in to provide bailout packages and to release a lot of money for guarantees and the purchase of bad assets, and performed this virtually overnight, bypassing all democratic procedures as well as those required by the constitution. This applied to the financial sector as well as to the real economy. Companies faced with bankruptcy were bailed out, whole industrial sectors were subsidised. The car industry, for instance, received scrapping bonuses ('cash for clunkers'). These efforts did not prevent the financial crisis from developing into an economic crisis. And during this economic crisis, the real income of the masses dropped even further. The profit rates recovered to some extent, production was lucrative again and on average growth moved slightly upwards. But differences from country to country were now greater than ever (see the rich literature on the development of profit rates, e.g. Duménil and Lévy 2002; Harman 2010; Kliman 2009; also Altvater 2010). Some countries, with surpluses in their balance of payments, a strong currency and high financial claims, survived without too much trouble, but other countries experienced a serious public debt crisis. The Mediterranean states of the Eurozone were affected particularly badly. The public debt crisis was then converted into a euro currency crisis, which has the potential to shatter the euro currency zone that was set up in 1992.

Scarcity and shortage

The systemic constraint to overproduction, which is emphasised during a crisis, has characterised the industrial-capitalist system since its formation in England in the second half of the eighteenth century. Surplus production was enormously increased when the more diffuse solar radiation energy was replaced by the more compact fossil fuel energy. The productivity of labour also increased. Work processes were accelerated in time and their spatial range expanded. This is a 'historical lost property'; the potential of fossil fuels to raise the productivity of labour is immediately utilised in the capitalist economy. The surpluses needed by the system are expanded, while the extensive growth of labour volume is now supplemented with the intensive growth from substituting biotic energy by fossil fuels and hence with the increased productivity of labour.

The surplus is related to the capital invested as profit rate or shareholder value. Capital is borrowed beyond the limits of equity and interest has to be paid. The use of capital is thus disciplined. The instrumental rationality of the capital owners promotes this: they swing the 'pioneering banner of modernity' by gaining the largest possible profit from the smallest possible amount of invested capital, i.e. striving for and attaining the greatest possible growth. The addiction to growth is satisfied with the economic adrenaline supplied by finance markets that have meanwhile gone global.

But there is another side to the story: the limited ecosystems of the planet are over-used by increasing productivity and subsequent accelerated growth – in the worst case until the planetary nature collapses, to the 'ruin of mankind', as Karl Polanyi already warned more than half a century ago (Polanyi 1944). For growth is only possible when mineral and agricultural resources: i.e. finite and renewable resources, the fossil fuels (coal, oil and gas), are exploited from nature and transformed into those products that maintain growth and the accumulation of capital, and therefore also the production of everyday goods and services. Significantly, people need some of these goods and services to meet their needs – but this is still a side effect. The main point is the economic surplus, the profit on invested capital, which is calculated in monetary units.

The waste and other harmful emissions of production, circulation and consumption that are deposited in various spheres of the Earth are in no way insignificant. These range from atomic waste, for which there is no safe final dumping place anywhere on Earth, as is regularly admonished politically, to the combustion products of fossil fuels, the greenhouse gases of the atmosphere. These change the Earth's radiation balance and result in heating the atmosphere, with consequences that are globally debated as climate change or, ever more dramatically, as the coming climate catastrophe. Thus, it is not only economic and social structures that are restructured by the growth process but nature itself is also fundamentally altered.

This cannot be otherwise, since, as Immanuel Kant already knew, mankind cannot 'disperse without limit' on the 'surface of the earth . . . as a round sphere'[4] and create resources as from an infinite treasure of plenty (Kant 1795 [1984]). The world is meantime approaching what Richard Heinberg (2007) called ‘peak everything’ in the globally organised metabolism between mankind, societies and planetary nature.

Food is running out for the capitalist Moloch, which is consuming raw material and energy. At the same time, the dumps and pits of planet Earth where the Moloch has until now deposited its waste are overloaded. Waterways, from small streams to great oceans, are soiled and polluted. The land has become scarce and what is available is degraded, sometimes even poisoned. Thus, we should not only discuss ‘peak oil’ when approaching ‘peak everything’, but also ‘peak soil’ (see Fritz 2009). The peaks concerned are also of significance for economic categories. It is now necessary to understand scarcity and its implications. Contrary to shortage, scarcity is a well-known category in economic theory, because it is pivotal. Money or time is always limited with respect to the needs of the economic actor and with regard to the effort that must be extended to produce goods to satisfy needs. We are only prepared to pay a price in the marketplace when the goods are scarce. Without scarcity, economy as the science of the rational allocation of resources and their alternative use would be superfluous. Consequently, prices are prices of scarcity. The interest on borrowed money is also a price of scarcity: it serves as a ‘hard budget constraint’ whose absence has been made responsible for the inefficiency of socialist economies previous to 1989 (Kornai 1986). On the other hand, the shortage owes its significance to a dynamic theory of economic growth or the accumulation of capital – because it is inescapable that a growing economy will reach limits that occur as a peak in a finite world, that is, as an increasingly large ecological footprint, as a shrinking environmental space or even as a shortage in energy, water or resources.

The closed fossil energy system

Scientific and political discourse now discusses that it is absurd to plunder resources and overload pits, and thus saw off the branch on which we are sitting. But this is the consequence of an equally absurd law inherent to capitalism. Before the industrial revolution, the driving energy of the planet and of life on Earth came from the sun, and the heat of used solar energy was released into space. The closure of the energy system followed the early capitalist ‘enclosures’, when capitalist tenants took possession of the land, and ‘dispossessed’ or ‘expropriated’ the working class so that workers were compelled – often by physical violence – to sell their labour on the market. This happened in England during the ‘primary accumulation of capital’, as Marx so impressively described (Marx 1962 [1867]: vol. 1, chapter 24; see also Malanima 2010). The process of enclosure of the planet in relation to energy occurred during the industrial revolution of the eighteenth and nineteenth centuries. Before that, the planet was a kind of ‘photon mill’ linked into the solar energy flow (see also Ebeling 1995). Now the fossil fuel reserves stored in the earth’s crust are used. The ‘subterranean forest’ (Sieferle 1982) has been mined.

Seen from the Earth, solar energy is an external energy source. It flows from the solar fusion reactor, which is located in space at a ‘secure distance’ of 1,496 million km from the Earth (as Hermann Scheer said at the IPPNW Congress on Atomic Power, 2004). The solar radiation intensity at the edge of the Earth's atmosphere amounts to about 1.367 kW/m^2 (kilowatts per square metre). Only a small proportion of the radiated energy penetrates the atmosphere and reaches the Earth's surface; the rest is reflected (this is called the Albedo effect). Thus, on annual average, the radiation density on the Earth's surface is only about 165 W/m^2. This radiation is the energy source for plant photosynthesis and the basis of all life on Earth. This 165 W/m^2 does not sound like very much. But the total amount of radiation energy over the whole of the Earth's surface is more than 5,000 times greater than the current energy consumption of mankind.

This is no reason to be unconcerned. Plants can only convert about 1 per cent of the energy equivalent of more than 4.2 × 1,017 kJ (kilojoules) of free energy to biomass through the photosynthesis process.[5] This only occurs when sufficient water and nourishing elements in the soil (especially nitrogen, phosphorus and potassium) are available. By human standards, solar energy is inexhaustible: the 'photon mill' has a powerful potential of primary solar energy that can only be incompletely converted into usable secondary energy with the aid of wind or water mills, or in the form of biomass, or by photovoltaic or solar thermal means.

Since the industrial revolution, however, the energy for spatial movement, for producing heating, for light and performing work comes from the fossil (and nuclear) energy reserves of the planet (practically 'the Earth's own means') to an extent of 80 per cent. The emissions, especially the greenhouse gases, remain in the atmosphere for a very long time, about 120 years in the case of CO_2.

Economically, the replacement of renewable solar radiation energy by fossil (and nuclear) stored energy during the course of the industrial revolution in the eighteenth and nineteenth centuries was indeed a revolution: it now became possible to organise production conditions according to the principles of capital, without consideration for the limits of nature, the laws of thermodynamics or the evolution of species. The limits of capital valorisation[6] could 'grow', although at the very high price of ignoring the natural, social and cultural conditions of reproduction of the workforce and with the acceptance of an enormous destruction of nature. This is the ecological core of what Karl Marx described as 'real subsumption' of labour – and as we must now add, of nature as well – under capital (Marx 1962 [1867]: vol. 1, chapter 14). It was now possible to increase the surplus value – that is, the economic surplus in the form of profit – not only directly by expanding labour volume and increasing work speed but also indirectly, by increasing the productivity of labour.

Growth, which is the result of increased productivity, always requires a substitution process (as mentioned above). When productivity is to be increased – and this is the mantra of the capitalist mode of production – then the utilised energy must be more dense than the previously used biotic energy. The 'industrial revolution' depicts the replacement of and marginalisation of the less dense biotic energy by the denser fossil energy, with a high 'energy return on energy invested' (EROEI).

Increase in labour productivity evolved to be the dominant form of exploitation and the production of the systemically necessary economic surplus in the twentieth century. The proportion of the overall working time necessary to produce the consumer goods of the wage earners needed for reproduction of the workforce was reduced. More time was available – for a given working time – to produce added value for capital. The increasing surplus value was accumulated, and capital grew. Privileged members of the working class could also increase their consumption, and so could be compensated for their 'damaged lives', as Theodor W. Adorno wrote, with access to the 'aristocracy of workers'. Despite increase in pay, it was possible, through increasing productivity, to increase the proportion of product value that could be accrued to capital as (relative) surplus value or, phrased in modern terminology, to reduce the unit labour costs. This was enabled through the use of fossil energy and the adaptation of the transformation systems to fossil fuels, and was enhanced by the 'spur of competition' beyond 'big industry', as termed by Marx, to Fordism and towards finance-driven post-Fordism, the asset-based capital growth regime of our present era, which is responsible for the multiple crises.

Now it is apparent that the ecological absurdity of changing from an open, solar energy system to a closed fossil system is due to an absurd form of economy. The growth of capital is measured against capital itself. The absurdity becomes a paradox. Since the industrial revolution, fossil fuels enabled the increase in labour productivity and consequently also high real economic growth rates (see data in Maddison 2001). Fossil energy is limited with regard to available resources and reserves and also with respect to emissions, whereas the growth of capital, which makes use of the resources, is only measured against itself. Capital – not nature, moral law or the sky above – is thus the ultimate measure of all things. Contradiction emerges between the transformation of materials and energy taken from external nature and the expansion of abstract economic value in the valorisation process. The imperative of capital exploitation does not accept any boundaries that are marked on the finite 'spherical surface' of the planet Earth. However, they assert themselves as limits of growth and accumulation and thus they are marked and reported (see www.footprintnetwork.org/en/index.php/GFN/). The imperative of capital exploitation and the constraint to growth remain, but they are given an attribute. Growth must be 'green'.

Expanding limits or the rationality of time and space

Within the double crisis of economy and nature, smart people have come up with the idea that limits to growth can be avoided by widening the limits. A green spirit like Peter Sloterdijk has already discovered a new planet on the other side of the earthly horizons (Sloterdijk 2011), because the Noosphere is not confined by time and space, as are the other spheres of planet Earth. Calculations based on the ecological footprint show that the 7 billion people on Earth would need 2.8 planets to maintain the consumption standards that are enjoyed in Germany (see, for example, www.footprint-deutschland.de/). Even if the two to three planets could be magically created, the natural law remains that these limits do not disappear: they only change their location, their extent and consequently their effects. Before peak oil, new discoveries of oil reserves increased the stocks of oil, although oil consumption also expanded every year. Known and even unknown oil resources were explored, recovered and added to the reserves. This worked well for decades. The limits of the reserves grew, but the resources were diminishing. The need to respect time and space is inevitable, and also to respect their coordinates, which always mark limits.

When there is no more 'easy oil' after peak oil, there are still the unconventional reserves of 'tough oil': oil from the rain forests, from the polar seas where ice caps are disappearing as a result of climate change, deep sea oil, tar sands and oil-bearing shale in Canada, in Venezuela and elsewhere (Klare 2011). There are reserves, without question, and the limits grow when they are exploited. Perhaps high-level oil supply can be maintained for some time with 'tough oil' when the supply of 'easy oil' reaches its physical and economic limits. But accessing non-conventional oil has had catastrophic effects, as the residents of the Niger Delta, Alaska, the Gulf of Mexico, the North Sea and elsewhere have had to endure. In addition, extracting non-conventional oil is probably only possible with increased cost and at the price of social, political and military conflicts over oil. Thus, new oil discoveries can delay but not avoid the demise of the fossil fuel era. In addition, due to the greenhouse effect, the expansion of oil supply draws the limits of the climate system tighter still. Limits do not, of course, disappear when they expand, so they remain contested.

New fields of conflict emerge. Subterranean water reserves that are very often tapped for industrialised agriculture can dry up. Soil can be lost. Even the flow of solar energy is limited, since the intensity of radiation varies (that is, according to the time of day and year, and according to location on the planet) and its energy density cannot be increased, or only with considerable input of (mostly fossil) energy. Consequently, Juan Martínez-Alier wrote: 'The productivity of agriculture has not increased but decreased from the point of view of energy analysis' (Martínez-Alier 1987: 3). We have just begun to celebrate the expansion of limits due to renewable agrifuels and we are already taught the opposite with new limits in the production of agrifuels.

The utilisation of biomass created by solar energy remains under the sword of Damocles, the threat of peak everything. Its use depends on whether sufficient quantities of water and nutrients are available today and tomorrow and whether they are available at acceptable extraction and production costs. This prerequisite prescribes relatively tight and by no means expanding limits to social energy metabolism, the energy household. Fossil (and nuclear) energy sources follow the Hubbert curve, with a peak of exploration and exploitation of reserves. Availability decreases after this peak. All finite resources have a point of maximum availability. Renewable sources, which in principle cannot be exhausted, can also have decreasing availability after a peak, when exploitation progresses faster than the rate of renewal and when conversion of renewables to usable energy requires certain materials whose availability is limited.

The natural and social limits have been known since the landmark publications by the Club of Rome in 1972 and by Fred Hirsch in 1977 (Meadows *et al.* 1972, Hirsch 2000), even though the prevailing critique of growth mostly did not seriously acknowledge the mechanism that drives growth: corporate competition, the hunt for profit and the pressure of the financial markets exercised through interest rates to produce real surpluses.[7] The contradictions in capitalist accumulation constitute a limit, too – which is supposed to lose its horror, thanks to the insinuated 'greening of growth'.

The produced space

Natural space contains that great arsenal which delivers working tools and materials for social reproduction, as claimed normatively by the philosopher Henri Lefebvre (1974). Consequently, social relationships with nature need to be examined: first, the constitution of physical space, i.e. climate, ecosystems, landscape, mineral wealth, etc., which are pivotal to developing the opportunities of a society; and second, the way in which humans appropriate nature for their purposes. According to Lefebvre, natural space permits a specific intervention, and not just any kind of human intervention. Natural space not only permits, it also limits. Only if we were living in an inexhaustible nature could we avoid the firm constraints imposed by the limits of environmental space and the irreversibility of time. Nature does not permit alteration or manipulation at will. Nature has its own materiality, its own rules and its own unique aesthetics. If mankind wants to survive, the specific particularities of manageable landscapes, but also planetary boundaries have to be respected, since these boundaries prescribe secure interaction with the natural base.

Consequently, the economy (and its growth) should become green (UNEP 2011a; OECD 2011a). Greening the economy is as difficult as squaring the circle. A well-known trick should help: the contradiction between economy and ecology is solved by classifying nature as 'natural capital' in economic categories, when the 'services' it provides are given a market price. Nature as natural capital will not only be comparable to all other forms of capital, but also exchangeable: investors move from shares (financial capital) to raw material bonds (natural capital). Detrimental effects on nature can also be monetarised by issuing and commodifying ownership rights and certificates. These 'market-based' categories show the contribution from 'natural assets' to 'wealth, health and well-being' (OECD 2011a: 10). 'Natural capital is to be excavated for the green economy' (Unmüßig 2012: 5) by using it as a 'growth motor' – in a sustainable way, of course. The concept of a green economy directly links to the sustainable utilisation of nature in production and consumption. North and south, capital and labour, the indigenous population and women all benefit from this utilisation. Green economy is portrayed as a 'win-win' world.[8] With these assumptions, ecological boundaries to unlimited valorisation of capital in the evocations of economic growth are removed, at least in the debate.

We have to acknowledge that today's environmental space is to a large extent manmade. Nature is produced nature, according to Neil Smith (Smith 1984): it is always a space that has been influenced, shaped and transformed by humans. The forces of production used by different societies and generations have affected planet Earth for centuries. Nowhere is the natural space left in its original state; we find a 'built environment' everywhere (Harvey 1982). This environment is capital after nature has been commodified and transformed into the capital form. We have to remember that nature itself is not (nature) capital, just as humans are not 'human capital'.

The term 'built environment', first, refers to the simple fact that capitalism is not conceivable without spatial fixation of capital, as Lefebvre also emphasised. This capital fixation is in the form of factories, shopping centres, transport and communication systems. Immovable capital embedded in the ground with a long turnover time, so-called fixed capital, is necessary so that other, mobile forms of fixed capital (machines, tools, etc.) and workforce can be readily moved in space (Harvey 1982, 2009). Energy is necessary for this.

Lefebvre and Harvey also discuss the interconnection between physical space and the social relations within this space: whoever governs and defines the space also forms the social relations, interaction patterns and relations of dependency in and between societies as well as between nature and society – and therefore also the power relations and the modus operandi of hegemony in society. The term 'spatial fix' indicates that today's industrial societies have repeatedly managed to mediate conflicts and maintain relatively stable social relations with the help of certain spatial arrangements. As Harvey concludes with reference to Rosa Luxemburg, this also means that the conflicts and crises that capitalism constantly produces are outsourced to peripheral regions of the world, the so-called developing countries and emerging economies, and that the inherent sufferings are always imposed on those who are weaker and barely able to defend themselves (Harvey 2007).

The energy oligopolies that have been established in the fossil-nuclear era with their worldwide logistical systems draw their power from the formation of space, for the purpose of extraction, production, transport, exchange and consumption of energies. Conventional energy suppliers have little interest in an energy transition because of their long-term investment in exploration, mining systems, power plants, supply, grid and distribution systems carried out over many decades. 'But the fact that some instruments of labour are localised, attached to the soil by their roots, assigns to this portion of fixed capital a peculiar role in the economy of nations'[9], as Karl Marx declared in the second volume of 'Capital' (Marx 1986 [1893]: chapter 8: 163), long before Harvey and Lefebvre. These instruments of labour 'cannot be sent abroad, cannot circulate as commodities in the world-market' as constructed artefacts (ibid.), if the conditions of valorisation deteriorate in the place concerned. The spatially fixed capital is consequently especially vulnerable to devaluation, and infrastructure must be continuously and permanently used to full capacity to avoid premature depreciation.

This also applies to transport infrastructure, which is tailored to the car, i.e. to roads and motorways moulded as concrete monuments of the oil age. They cut through the landscape everywhere and not only channel the everyday lives of humans in the same directions (and recurring traffic jams), but are paradoxically also linked to the contrasting idea of flexibility and mobility for all. This obstructs the necessary steps needed to move towards other, more environmentally sound models of mobility. Instead, agrifuels are used to maintain the current model of mobility. Obviously, the oil, car and biotechnology industries have equal vested interests in this. This ensures that everything stays as it is for as long as possible. As an 'admixture to conventional fuels, agrifuels maintain the existing enormous investment in oil production, refineries, car factories, petrol stations, etc. and save billions of profits for an indefinite period, by greenwashing them with the additional label of "renewable energies"'[10] (Pye 2009: 443).

The path dependence for providing energy is very distinctive. The high cost of infrastructure has tied up a lot of capital that is intended to generate a profit, at least over the lifetime of the borrowed credit (which it must provide due to worldwide competition). The capitalist mode of valorisation does not permit a quick transition to renewable energy sources without an enormous effort. An energy transition will only be possible after the depreciation of large investment projects – or not even then, since significant extra profit can be achieved if facilities can be used which do not cost anything because they have already been amortised and written off.

The finiteness of renewable energies and metals leads to a significant consequence: the restricted availability of those resources that are indispensable to renewable energy sources prevents the quick transition from fossil (and nuclear) energy sources to renewables. Apart from geothermal energy, the sun, which is the source of all renewable energy, does not shine on Earth constantly or in a concentrated form. Consequently, the sun cannot be used in the same way as fossil energy sources for production processes and transport, whenever there is a need in the capitalist production process. However, the few centuries for which this was possible with fossil energy are coming to an end. The shortage of fossil fuels is obvious. Prices are increasing and are a burden to consumers, at least when fuels must be imported and the elasticity of demand is low (see IMF 2012).

Long-lasting (economic) life driven by the sun's flow of energy would be possible if the capitalist economy could be unleashed from self-referential monism, the logic of looking only to capital growth. Instead, life could be adapted to the solar rhythm and abolish the reliance on finite mineral and fossil resources. Production and distribution would have to slow down, at least with the current technological basis. We would have to manage with fewer economic surpluses or do without them. The accustomed increase in production of the fossil era would be reduced or even vanish. The programmes of 'growth acceleration' developed all over the world would obstruct this. This may mean that the solar rhythm could only be followed if the capitalist form of economy were modified in a 'Great Transformation' (WBGU 2011).

Blocked escape routes out of the multiple crisis

How can the crisis be overcome? In principle, by increasing real surpluses to improve capacities of debt servicing and, or alternatively, by reducing financial claims at the same time. Four possible paths can be followed, which, of course, turn out to be cul-de-sacs or are being closed politically.

The first escape route from debt is the politically enforced redistribution of income and wealth. Debt payments necessarily tear a huge hole in the 'secondary budget', where the accounting of debt servicing occurs. This is increased because states have had to bail out private banks and other companies, and because the rating agencies devalue creditworthiness if there are fears of problems with debt servicing. So the spreads on the interest rates are increased, and hence the interest burden of the debtors concerned. As a result of this, the primary budget, which, among other items, contains welfare payments, public investment, expenses for public security, etc., must provide a surplus: if taxes on mobile factors of production (capital) are a no-go, then taxes and fees to be paid by immobile factors of production – i.e. wage earners – have to be increased and the expenses for wage earners have to be reduced. Austerity measures, euphemistically called state budget reductions, give rise to severe social security cuts, wage and salary decreases, cost reduction in public goods and also a practically universal increase in public fees and charges.

The austerity measures performed by the nation state are supported and safeguarded by international politics, by the conditionality of the International Monetary Fund (IMF) since the 1980s, in the European crisis with agreements between the EU, ECB and IMF, i.e. by the creation of the so-called Troika. This is a successful method of making these policies for redistribution in favour of the financial asset-holders inescapable. It is a declaration of war in distribution policy, and leads to grave social conflicts.

On a second path, the financial claims that creditors have on debtors are reduced in order to find a way out of the financial crisis. Debt may be reduced or even cancelled by examining the legitimacy of the debt in the course of a 'debt audit'. To do this, the power of the rating agencies would have to be reduced, since they alone assess the creditworthiness of debtors and the credit rating of securities, but do not consider the productive capacity of debtors, the legitimacy and the adequacy of debt service, the legal and moral validity of debt claims, the integrity of creditors or their identity. Absurd ratings are generated in this way: the interest rates of the debtors rise as the difficulties in servicing the debt increase because of these ratings. This is an automatic process, and leads to bankruptcy. If we must have a credit rating, then it should cover the entire credit relationship and not just the debtor's part.

A reduction in debt payments would thus require a debt relief from the creditors, a fair, efficient and transparent insolvency regulation that considers the interests of all stakeholders in the credit relationship. Insolvency regulations currently only exist at the national level. They do not exist in international credit transactions; 'sovereign debtor' insolvency regulations have always been called for but have not been established up to the present (see Kunibert Raffer's website: http://homepage.univie.ac.at/kunibert.raffer/art.html).

On the third path, the speculative supply of capital would be cut off. This could be achieved through a property or wealth tax or levy and a financial transaction tax. The aim would be to tap those financial assets that are not spent on consumption because the asset owners already have everything they want many times over, and which is not invested because the profit that can be earned is too low in comparison to financial returns, and so they are invested in financial assets. There is powerful resistance to taxation on property because neoliberals follow the advice of Friedrich August von Hayek (this classic reasoning is found in von Hayek 2004 [1944]), to try to cement all measures of market liberalisation into international treaties and agreements, so that the hands of national governments, were they ever to consist of the 'wrong' (non-neoliberal) parties, would be tied.[11]

A fourth path is outlined by the optimists: the GDP growth rates could be brought to such a high level that those countries in debt could grow out of debt and thus simultaneously out of the financial crisis; limits to growth are a thing of the past. This was the main ideological message of the World Bank's debt cycle hypothesis in the 1980s: 'growth-cum-debt' became the magic formula to turn a debtor country into a creditor country. At first, a trade balance deficit caused by importing investment goods is financed through external debt. Then the trade balance deficit is gradually reduced by exporting competitive goods, which are produced through credit-financed investment. Finally, export surpluses can be used to reduce the debt. The previous debtor country is transformed into a creditor country. This has little to do with the reality of the capitalist world system, even the way it functioned in the 1960s and 1970s when interest rates were relatively low. In addition, with today's finance-driven capitalism, real interest rates would have to be pushed down below the real growth rate so that growth-producing investment would be more attractive than financial investment. However, this would contradict the self-referential character of the financial markets and the institutions, such as rating agencies, that are running the global markets. Moreover, growth would not be wise considering social limits, the depletion of resources and the overloading of the dumping pits available to us and to future generations on the planet.

The energy mix of the capitalist system

In the transition from fossil to renewable energy, for instance, the use of biomass as fuel has led to the emergence of a competition in land use between 'tank or plate'. This is not the only cause of land competition and conflicts, of course, but it constitutes an important factor. Millions of people suffer from hunger or malnutrition in many regions of the world, despite the Millennium Development Goal to halve the number of hungry people before 2010. Climate change is one of the many causes of this, in addition to the conflicts over the use of crops as food for humans or as feed for livestock – or as agrifuel for cars. Alhough biomass is essential for the future energy system, it cannot satisfy the ever increasing hunger for energy in a socially and ecologically feasible and sustainable way.

Nearly 100 per cent of the energy that makes life possible comes directly from the sun: we can neither eat coal nor drink oil. Of necessity, we need the production of renewable energy from biomass. In the pre-industrial era, labour energy was mainly provided by wind and water, biomass and animals. Today, however, more and more fossil (and nuclear) energy is being used. The lion's share of 80 per cent of global energy consumption consists of fossil fuels such as oil, coal and gas from which electricity, heat, light and petrol are obtained.

Apart from fossil fuels, nuclear energy also plays an important role in the global energy mix, and it is mainly used by industrialised countries to meet their electricity needs: 80 per cent in France, and about 50 about in Belgium and Sweden. The USA is the world's largest producer of nuclear energy in terms of quantity. A fast nuclear expansion first occurred in the industrialised countries because of the oil price crises of the 1970s, and the need reduce oil consumption despite the increasing production of electricity. The proportion of nuclear energy in world power generation increased from 2 per cent to 15 per cent between 1971 and 2006 (OECD 2009: 120). However, only 12 more nuclear power plants were added to the 423 existing reactors in the two decades between 1989 and 2009. This was the effect of the Chernobyl catastrophe (Mez and Schneider 2009: 436). Many industrialised countries and emerging markets, especially China, South Korea and India, currently want to expand their nuclear capacities, despite the still unsolved problems in operational security,– as the Fukushima accident of March 2011 showed. In addition there are– the difficulties of final storage of nuclear waste over thousands of years and the ever present threat of using nuclear energy for military purposes (the double-use problems and proliferation). Nuclear energy, with all its (transnational) dangers, is currently being produced and consumed to an extent of 83.3 per cent in OECD countries (IEA 2010a: 16).

The largest consumers of fossil and nuclear energy are also the largest contributors to climate change. The energy sector of the rich countries alone is responsible for 84 per cent of CO_2 emissions (IEA 2009: 168). This is the continuation of the more than 200 years of industrial development. This, together with massive individual transport over long periods of time, is the reason why rich countries have pumped most of their emissions into the atmosphere. Although climate change is only one of several dimensions of the crisis-ridden social relationship with nature, climate impact is especially severe due to its global scope. Disastrous, sometimes irreparably detrimental effects on certain regions can grow and, together with numerous small-scale destructions, add up to a global problem if species become extinct or soil, water and air are polluted and made unusable. Climate change, however, interacts with many ecosystems, and will be experienced throughout all regions of the world. A worsening of ecological conditions because of the greenhouse effect can be expected to amount to an existential threat to human life – through food crises, water shortages and loss of habitat – initially in parts of Africa, Latin America and Asia. Shortage of capital, deficient infrastructure and low social and political capacities to mitigate or adapt to already perceptible detrimental effects all lead to life-threatening consequences.

It is disillusioning that the present contribution of renewable energy to the entire energy consumption of the rich North is still small (with the exception of countries such as Iceland and Norway, which use their natural advantages in water power and geothermal energy). Renewables are technically less profitable to capital than fossil and nuclear energy, and therefore the transition to a solar energy path seems to be relatively unattractive for energy providers.

If big capital has its say in the energy market, then the required systemic changes will be delayed, avoided or downgraded to small-scale modernisation projects. For instance, there is a range of technology-based and market-based approaches to solve the energy and climate problem (Altvater and Brunnengräber 2008). Yet only some factors or instruments in the means of production are replaced, mainly to enable the continued existence of the fossil system. As part of the utilisation of capital to new conditions, enormous financial means are invested in the development of technologies that actually only serve to protect the existing infrastructure of the fossil (and nuclear) age from impending devaluation. Supposedly 'climate-friendly' nuclear energy was to be expanded, to contribute up to 25 per cent of world's energy use by the year 2050 (OECD 2011b: 134f.)–. But this goal has fallen victim to the catastrophic nuclear meltdown in Fukushima – at least in some countries, as the example of Germany shows. However, the use of fossil fuels is to be continued until the bitter end. The fossil-nuclear development path will be taken even when nuclear phase-out has already been decided and peak oil signalises the end of the oil age.

Energy and power: large-scale technology versus decentralisation

How can the commitments on reducing greenhouse gas emissions be fulfilled if oil, coal and nuclear power are still to be used for several decades? The large-scale energy utilities that were established in the fossil and nuclear age require large-scale technological solutions. These include various remedies, from the underground storage of CO_2 (carbon dioxide capture and storage, CCS), because then the use of coal becomes feasible again (since peak coal is further ahead in the future than peak oil or peak gas), to measures for increasing albedo, that is, increasing the reflection of solar radiation back into space and simultaneously decreasing incoming radiation with a radiation filter (e.g. releasing sulphates into the upper layers of the atmosphere). All these measures have a planetary reach and are therefore labelled as 'geo-engineering', which constitutes a new age of Earth history, the 'anthropocene''. Geo-engineering could successfully combat the greenhouse effect – at least according to the geo-engineers. However, apart from the technical feasibility, the sky would no longer be blue but more like a sulphurous yellow, surely leading to depression among those who once knew the sky to be blue. The simple rule of thumb that states that the effects and thus risks of a technological project increase with size also applies to large technological experiments to make 'the limits' of the fossil-nuclear energy regime 'grow'.

In the EU there are now several experiments to apply large-scale technology to explore the European potential for generating and using energy from renewable sources. Huge solar thermal power stations in the Sahara desert and wind parks in the flatlands near the coast or offshore at sea are among the monstrous attempts to correct energy shortage after the fossil and nuclear age, and to correct climate change with large-scale technology. Transregional and transcontinental structures for the renewables that follow the model of old energy supply systems are also advocated and established.

First: today, Desertec is the most discussed project of post-fossil energy production, even though the first ideas of generating electricity under the Saharan sun had been suggested in the 1980s (see Radkau 2011). Solar energy is to be captured with solar thermal technology, principally in the Sahara, and turned into electricity to be then distributed via a 'smart grid' to at least two continents (Africa and Europe). The costs are currently estimated to amount to the enormous sum of €400 billion. Concentrated technical interventions on a large scale entail risks and the planned sea of mirrors in the desert has a dark side that can have – literally – climate-relevant effects. However, the effects of Desertec on the regional climate seem to not have been comprehensively assessed (Hulme 2001; www.isomorph.it/letters/ articles/desertec/desertec-1). It could turn out that producing solar energy locally in Europe would be cheaper than doing so in the Sahara, if all aspects of the large project are to be considered. ETC Group states, 'if we don't know, don't change it', in a report that critically analyses corporate-dominated agriculture, new technologies and renewable energy (see ETC Group 2009).

Second*:* the offshore wind parks are also to be rapidly expanded in the North and Baltic Seas, where the wind is stronger and more constant than ashore. Combining these projects with decentralised energy production would enable a constant energy supply without large voltage fluctuation, just as large power stations based on fossil or nuclear energy have managed to meet basic capacity and peak-time needs. The climate problem seems solvable, since solar energy production and distribution causes no direct and only low indirect CO_2 emissions. However, apart from the billions for the construction of new facilities, further investment is necessary for large-scale distribution grids to connect the areas of energy production with those of consumption. In Germany alone, an expansion of the electricity lines in the distribution grid of about 3,500 km would be necessary by the year 2020 (mainly to connect offshore wind parks in the North and Baltic Seas with the places where the energy is required), necessitating an investment of several billion euros according to the German grid agency (dena 2010). Environmental associations and independent consulting companies doubt these numbers, however. The state is intervening with specific regulations to prevent the expensive infrastructure projects from turning into a bottomless pit.

Hermann Scheer was concerned that investment into renewables would be limited so that the utilisation and refinancing of the grid would not be endangered. Consequently, Scheer considered projects like Desertec and offshore wind parks as a 'political weapon on the whole against the expansion of local and regional solar and wind power production' (Scheer 2010: 152), which politicians put into the hands of a few large-scale energy suppliers. The correlation between spatial and social order, that Lefebvre emphasised so often, applies even with regard to the renewables: infrastructure systems also determine a society's long-term relationships of power and domination.

Third, the production of biomass to generate biofuels can also occur in large-scale projects in large monoculture plantations. The production of biomass on a large scale is usually unsuited to small-scale agriculture. Because of the political, social and ecological conditions of large-scale biofuel production in Europe, large agricultural producers in Brazil – but also in Indonesia, Malaysia, South Africa or Argentina – see their chance in biogene energy: they can expect to achieve comparative cost advantages on the global market, profiting from the regional climate, natural space and the availability of agricultural and forest land, as well as low wage costs. Currently at 2.2 per cent of global bioenergy use, the input of biomass into transportation is still low. Consequently, organic materials are used mainly to generate heat and electricity: traditional forms of heat production in developing countries amount to 85.6 per cent of global bioenergy use, only 7.8 per cent representing bioheat produced in modern facilities and 4.5 per cent representing bioelectricity (WBGU 2011: 37). The production of biofuels, however, has increased rapidly in the past few years. Production increased from 16 billion litres in the year 2000 to more than 100 billion litres in 2010, according to the IEA (IEA 2011a: 55) – and biofuels will play an increasingly significant role in the coming decades. This trend is propelled by the politically defined mixture quotas in many countries. If the supply corporations from the fossil age integrate the expansion of renewable energy sources, such as wind, water, photovoltaics and biomass, into transregional and transcontinental structures, then these are also chained to the inherent logic of growth and centralisation of decision-making. This perception is seen by Joachim Radkau as the 'quintessence' of the life of Ludwig Bölkow (founder of an arms corporation and active in solar technology): 'The solution of a problem must fit into the whole system' (Radkau 2011: 481f.). Against this background, generating energy from renewables has the effect that the facilities are built where they yield the highest profit: for instance, energy crops and agrifuels are imported from the most fertile soils in Latin America, Africa and Asia to the industrial consumption regions. This is made possible by the WTO free trade agreement.

This approach, to generate new energy for transformation, distribution and consumption systems inherited from the fossil age, could also be seen allegorically as an 'energy slave hunt'. The energy slaves, as Hans-Peter Dürr called them (Dürr 2003), are in the rich North, which provides the – highly relative – comforts of fossilism: high and globally expanding spatial mobility, accelerated communication, heat and cooling, artificial light. And they activate the numerous technical aids in production and in households. The energy consumption of the nearly 7 billion people currently on Earth corresponds to the 'impact of 130 billion energy slaves, whereby four energy slaves perform the physical labour of a horse (PS) twelve hours a day without pause', writes Hans Peter Dürr. To maintain his lifestyle, a US citizen requires on average 110 energy slaves, a European 60, a Chinese 8 and a Bangladeshi less than 1 (Dürr 2003). It is doubtful whether such a massive quantity of 'slaves' can be maintained using renewable energy.

Land use conflicts

It is not always clear how environmentally friendly the use of renewables is, as has especially been shown in the example of agrifuels. The production of plants for energy ignores the rhythm of nature and is guided by the logic of valorisation of capital. These crops are often planted in monoculture on large plantations that require the use of chemical fertilisers and pesticides, need to be irrigated and are directly or indirectly the cause of deforestation of tropical forests. This neither leads to climate crisis solutions nor to solutions for the energy crisis. Instead, other crises are aggravated. This also applies to the food crisis: the livelihood and health of hundreds of millions of people are threatened.

Consequently, the change in the trajectory towards renewable energy fuels leads into an area rich in conflict. The extraction of fossil fuels – of coal, oil, and gas – had (and still has) an advantage that the renewables don't have: it requires relatively little territorial space because fossil fuels are extracted from the 'subterranean forest' (Sieferle 1982). If subterranean and submarine fossil energy could only be extracted from the land surface, because the sun shines only there and not under the soil, then an area 2.7 times the size of Europe would have been necessary for energy production around 1900, and a century later it would have already been 20 times the surface of the European territory because of the rapid increase in energy consumption (Malanima 2010: Chapter 2). Generating energy from renewable sources, especially biomass, is much more dependent on land and is extensive compared to generating energy from fossil resources. Indeed, fossil fuels such as oil are also transported from the drilling plants to the processing and consumption areas by tankers, trains, lorries or pipelines; consequently, the use of fossil energy also requires and affects large territorial areas. Additionally, these are protected by police and the military, because of the importance of energy security. Significantly, the fossil age involves the extraction of energy from the Earth's crust. This leads to competing demands on underground use, in drilling for oil and gas, mining, final storage of nuclear waste or even future large-scale CO_2 sinks in mines and exhausted oilfields: the subterranean spaces are pivotal to the fossil energy economy. It is the Earth's surface that is important for the production of agrifuels.

However, we have to consider that the extraction of fossil energy has led and repeatedly leads to massive and large-scale environmental damage in some regions because of deficiencies in technology, lax security measures and criminal activity, combined with political corruption: in the Niger Delta, in the rainforests and in the Siberian Taiga; and with gas fracking (the pumping of fluids under high pressure into storage reservoirs to increase internal pressure, causing fractures in the rock and aiding the extraction of unexploited deposits) in the USA, Germany and many other countries. This is different with renewable energy (with the exception of geothermal energy), in which energy production is relocated to the earth's surface. Of course, the planet is territorially limited and land is a good that is in short supply. The land demands of renewable energy producers can be met at the cost of other uses, and in the case of large technology projects these demands have negative social and ecological effects. Huge areas are flooded, rivers are diverted and dammed, animals displaced and humans resettled for the construction of hydroelectric power stations. Wind power facilities onshore are sometimes viewed as an aesthetic annoyance; offshore they must fit around fishing or shipping routes and can affect the equilibrium of sea life. Suitable areas have to be found for solar energy facilities as well, and these must be balanced against other uses. Desertec, for instance, will restrict the land access of desert dwellers. Pastoralists and nomadic shepherds are being displaced by the advance of agrifuel plantations in Latin America, Asia and Africa. If energy production is concentrated in seemingly unused areas in developing countries, then it may be possible to avoid the anger of the citizens in the capitalist centres who protest against the construction of solar and wind power facilities or against having the wasteland of agrifuel monoculture crops placed on their doorstep. But it is those people who live where solar energy and agrifuel production is located who will have to pay the price.

The spatial separation of energy production and consumption (also typical of the fossil age) has actually enabled the impact on nature and social life to be concentrated in some areas, with negative effects hidden from view to some extent. The integration of the space for energy production into those for energy consumption would be necessary in order to reconcile requirements for energy, ecology and social needs locally in a self-determining and democratic way (see Scheer 2010). It would be possible to create decentralised, small-scale structures for energy supply, since renewable energy – solar energy, wind power, biomass – is available and usable everywhere on Earth. Locally available sources would mainly be used for this. The creation of economic spaces would then be based more on geographical vicinity than on the global logistical systems of the fossil age. This would also provide the opportunity to end dependence on fossil energy centralism and the domination of large corporations, and to favour nearby energy supply. This would lead to a comprehensive democratisation of the energy economy, with decentralised forms of property and local self-administration.

However, the NIMBY ('not in my backyard') principle is also victorious in the brave new world of biogene energy production. The cultivation of energy crops requires a lot of fertile land, and consequently takes the land away from other agricultural crops, if the monetary returns exceed that achieved with the production of other agricultural commodities. The profitability of energy crop production depends, among other factors, on the price trend of fossil fuels on the markets. There is a significant increase in the use of agricultural land for energy purposes when fossil fuel prices move upwards, and this land is then unavailable for food-crop production or for other biomass production (e.g. the animal feed or fibres industries). This leads to price increases for all agricultural commodities (OECD/FAO 2009). Consequently, the increasing demand for agrifuels indirectly contributes to the pricing of agricultural commodities on the global market. And this in turn leads to impoverishing more people instead of increasing the prosperity of nations.

The agricultural markets have also been integrated into the global financial markets to a larger extent in recent years, and have been the target of speculative activities on an increasing scale. Small investors and big institutional investors seeking refuge from the global financial and economic crisis in the 'safe haven' of the commodity markets sought to protect themselves against the fear of inflation because of high public debt in all industrial (and developing) countries. Public debt itself has largely been caused by the trillions that have been spent to bail out financial institutions, mainly in North America and Europe. Derivatives traded on the commodity markets have become more attractive in periods of low interest rates; consequently, speculation on the futures markets for agricultural commodities has increased. Many observers regard this as being responsible for the enormous increase in food prices in 2007/2008 (Wahl 2009). There was another big increase in prices in the spring of 2011. Today, soya, wheat and sugar prices are 'financialised', and are correlated with those of oil, currencies or shares. This parallel development of fuel and food prices is a conclusive sign that speculation is the main cause of current hunger crises (Flassbeck 2011).

The speculation in agricultural commodities assets on global financial markets would have to be stopped to ensure access to food for the poor and at the same time protect small agricultural producers. Therefore, according to Fred Magdoff, speculation leads to constant fluctuations in price and 'as a result contributes to hunger for many – sometimes millions – when prices peak, and to the ruin of small producers when prices crash' (Magdoff 2012), and the latter further increases the extreme market concentration in the agricultural sector.

However, having emphasised the role of speculation, other causes of price increases in the real economy should not be neglected (see Höring 2011). A growing world population raises the demand for food. Additionally, nutritional habits are changing in emerging markets, where people insist on having mainly meat, fish and milk products on their plates, just as in the rich North. About 500 litres of water and 1 kilogram of wheat are needed for the production of one kilogram of bread, but about 7 kilograms of wheat fodder and 15,000 litres of water are required for the production of 1 kilogram of beef (von Oppeln and Schneider 2009). There are estimates that about one-third of the global increase in agricultural production that is needed to feed 7 billion people by the year 2030 is caused by the westernisation of nutritional habits. But this correlation between meat consumption and the global hunger crisis is often ignored.

Further causes of the increase in food prices in the real economy are stagnant production and the liberalisation of agricultural markets. This has been a central part of neoliberal doctrine since the 1970s. It has weakened agriculture, because it favours the influx (nearly tariff-free) of cheap agricultural imports (supported by subsidies on agricultural exports in the EU and in the US as well as other dumping instruments) into developing agrarian countries, and has consequently contributed to pushing local agriculture out of the market. The neoliberal structural adjustment programmes also required the reduction or even abolition of subsidies for agricultural inputs (fertilisers, pesticides) in the 1980s and 1990s. Measures for regional redistribution to benefit remote or less accessible areas – by the publicly subsidised purchase of the harvest, for example – were also terminated. Specific crop failures, which have occurred more frequently since the 1970s and have led to a reduction in supply, are possibly already caused by global warming, for instance in Africa. And, as mentioned above, agricultural conditions will also deteriorate, especially in many developing countries, because of future climate change.

Conclusion

The use of renewable energy can also have disastrous ecological and social effects. Just as King Midas turned everything he touched into gold, and in doing so provoked his own death, the capitalist mode of production tends to turn everything into money and to enlarge the ecological footprint with seven-league boots. Renewable energy, just like fossil fuels, can be a curse for humanity when made an object of profit. In contrast to King Midas, this is neither a myth nor a mystery. Whether a good idea also means a good life for everybody is in the end decided by the manner in which the economic system works. Satisfying human needs will remain a subordinate objective for as long as the production of energy and food is based mainly on profit. We have seen that following the principles of profit and growth has also contributed to the current global economic and financial crisis. This, combined with the energy, climate and food crisis, has turned into a great capitalist systemic crisis. We must not forget that financial losses, even though they amount to thousands of billions and have spectacularly intensified in the form of a financial, debt and currency crisis, are reversible. This is not the case with biodiversity losses, or with oil that is produced and consumed – and that is running out – or with hunger and hunger deaths, or with climate change. These losses are irreversible. We not only need a transition to renewable energy but also a change in production patterns and lifestyle in order to achieve a socially equitable energy supply that does not overburden the planet's regeneration capacity (very clearly described by Loske 2011). The protection of the natural environment, food sovereignty, equality in distribution and job security – all legitimate demands – are to be reconciled, by democratic means.

Notes

1 We are very grateful for the translation of the text from German into English by Ann Stafford.

2 Nuclear energy has also replaced solar energy since the second half of the twentieth century. We cannot address this here.

3 On the theory of rational expectations and the efficient-market hypothesis that has won Nobel prizes and acclamation in academic circles in the course of the 'neoliberal counter-revolution', George Soros said at the 2012 Annual Conference of the Institute for New Economic Thinking (INET): 'I am not well qualified to criticize the theory of rational expectations and the efficient market hypothesis because as a market participant I considered them so unrealistic that I never bothered to study them . . .'.

4 Translated by the authors.

5 The term biomass encompasses all materials of organic origin, i.e. carbon-based, but not fossil, material (according to Kaltschmitt *et al.* 2009). Biomass thus consists of: plant mass and animal mass (flora and fauna) that live in nature; the residues that result from these (e.g. animal excrement; dead (but not yet fossilised) plant mass (e.g. straw) and animal mass; and, in a wider sense, all materials that are produced by technical transformation or that incur through or from material use (i.e. black liquor, paper and cellulose, slaughterhouse waste, organic household rubbish, vegetable oil, alcohol).

6 Valorisation is a technical term used by Marx, which is readily understood in German ('*Verwertung*'), but has no direct equivalent in English (see http://en.wikipedia.org/wiki/

Valorisation). It means the expansion of the value of capital by creation of surplus value through exploitation of wage labour.

7 This article cannot discuss the increasing literature that criticises growth. This criticism avoids the correlation between the capitalist form of the economy and growth, and is therefore frustratingly boring and fruitless.

8 There is a broad discussion on this and on 'green capitalism', which will not be analysed further in this article. See the attempt to a systematisation in Adler and Schachtschneider 2010; the contributions in *Böll-Thema*, the Böll Foundation magazine, 'Grenzen des Wachstums – Wachstum der Grenzen [Limits to Growth – The Growth of Limits]' (*Böll-Thema* 2011); also the contributions of Hans Steiger, Bruno Kern, Andreas Exner and Elmar Altvater in *Widerspruch* (Steiger 2011; Kern 2011; Exner 2011; Altvater 2011).

9 Translation from http://www.marxists.org/archive/marx/works/1885-c2/ch08.htm

10 Translated by the authors.

11 The right-wing nationalist, conservative Prime Minister of Hungary, Victor Orban, as President of the EU Council, has adopted von Hayek's dictum: 'I make no secret of the fact that I (…) want to tie the hands of the next government (by means of the economic laws of his right-wing government; authors' note). And not only the hands of the next government, but the next ten governments as well' (*Junge Welt*, 22 July 2011, p. 11). Thatcher's TINA slogan, 'there is no alternative', is thus welded into an unmovable authoritarian commandment that directs an increasingly anti-democratic, authoritarian and neoliberal EU policy.