INNOVATIONS TO DEMOCRATIZE ENERGY ACCESS WITHOUT BOOSTING EMISSIONS[1]

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Introduction

The Third Industrial Revolution (Rifkin, 2014; Heck e Rogers, 2014) offers opportunities for transformations not only in the energy matrix but also in the way the goods and services that constitute global wealth are conceived, produced and used. However, for those opportunities to become actual realizations disruptive changes will have to be made to the current business models, to the protagonists of economic growth and to the rules that drive goods and services supply is organized. Unlike the features that marked the technical progress of the first and second industrial revolutions, the large scale use of digital media is already opening the way not only for a dizzying drop in the prices of renewable sources of energy but also to the emergence of collaborative forms of economic organization that may make it feasible for countries whose populations live in poverty or even destitution to gain access to those goods and services that form the base of what Amartya Sen (1999) considers development to be. The increase in efficient energy production using renewable sources and on the basis of self-production is such that it is beginning to threaten the business model that has indelibly marked the electricity supply since the day when Thomas Edison began to implant the American electricity grid. That is shown by the recent document of the Rocky Mountain Institute (2014) with its suggestive title "Grid Defection". Recent conquests in the capacity to offer goods and services coupled to energy saving (rather than increased energy use) are so promising and have already brought in results with such a strong impact that Lovins (2014) does not hesitate to refer to them as the "secret revolution".

Just as the widespread access to mobile phone services does not involve the prior installation of a centralized network with cable connections, so it must be queried as to whether the benefits of electricity in countries that are currently living in poverty must

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necessarily involve the predatory pathway of expanding fossil sources (or of the hydroelectric plants that destroy forest ecosystems) and only in a far off future arrive at renewable distributed energy. Up until just a few years ago, the high prices of modern renewable forms of energy (solar, wind, biomass and geothermal) meant that access to energy was almost inevitably linked to increasing the carbon space occupied by those living in poverty. At the end of the first decade of the millennium, Purkayastha and Mandal (2010) calculated that, in India, the cost of generating electricity using solar thermal energy was fifteen times higher than the cost using coal. Bill Gates makes the same point. He believes it is impossible to expand access to electricity without having recourse to fossil fuels on a massive scale (Shah, 2014). Everything goes to show that such reasoning is no longer valid in view of the increases in efficiency and reduction in prices of solar and wind sourced energy and, albeit to a lesser extent, the gains in productivity achieved by modern ways of using biomass.

The central idea of this paper is that the occupation of the remaining carbon space cannot be the central aspiration of the G77+China at the next two Climate Change Conferences. What is of overriding importance today is not to guarantee the developing countries the right to emit greenhouse gases (using the justification that, to date, the wealthier countries have done just that and, unless the poorer countries can do so too, there will be no expanded access to energy for them) for two reasons that will now be analyzed. Firstly (part two of this text, after this introduction) because that is a destructive course for human societies and life in general and therefore just as incompatible with the aspirations and ethical premises of the idea of mother Earth[1] as with idea of development as defined by Amartya Sen (2001). The second reason (Part 3 of the text) is that the technical means already exist to permit access to utilities on which the development process can be supported without any need for the energy matrix to be fossil-based or depend on new hydroelectric plants so harmful to forest ecosystems. Furthermore, those technical means are not only relevant for the production of energy but open up the possibility of collaboration and the increasing production of public and collective goods and services becoming the central axis of social organization.

The fossil fuels empire and the carbon bubble

Nowadays, contemporary societies have a real possibility of winning the fight against the catastrophic prospect represented by climate change. That statement is made in opposition to those who throughout the first decade of the millennium conducted some of the most important work on global warming. Robert Ayre (the most important contemporary expert on industrial economics), in his insuperable book co-authored by Edward Ayres, argues that the fossils are going to continue dominating the world energy matrix through to the mid-21st century (Ayres & Ayres, 2012:2). Far from adopting a defeatist attitude in the face of that perception, Ayres and Ayres (2010) propose decisive changes to the way energy is used to increase energy efficiency and in that way reduce greenhouse gas emissions. In their view, it is possible to double the quantity of useful goods and services that can be extracted from a unit of energy in the United States in a fairly

short term, by means of cogeneration, increased energy efficiency of the coal burning power stations themselves and changes in product designs aimed at reducing the energy intensity of their manufacture.

A new cycle of expansion of fossil fuel use based on the American shale gas (Maugeri, 2012) and non-conventional sources (among which the Brazilian pre-salt deposits) seemed to corroborate the idea that fossils would dominate the world economy for at least some decades to come. As an important United Nations report (DESA/UM, 2011) has shown, in 2010, of the US$ 710 billion spent on energy, only US$ 70 million were spent on renewable forms. Nevertheless, there has been growing evidence recently that the fossil economy faces problems that are so huge its endurance is becoming highly questionable. Let us take a closer look at the issue.

To Paul Gilding (2011), the idea that it is possible to consistently make progress in decarbonizing the global economy rests on two "tipping points". The expression refers to an accumulation of factors which, when a certain threshold is arrived at, revolutionize the dynamics of a given system and almost always do so in an irreversible manner. Economists and sociologists use the idea to explain brusque alterations to collective behaviors. That is exactly what is involved in the mutation of a social order based on fossil fuels to a form of organization in which renewable energies play the preponderant role.

The first tipping point: the use of fossil fuels over the last decade has put the human race in an extremely high risk situation. Continuing in the current rhythm will mean that there will be a temperature increase of 4ºC by 2060. As the recent World Bank report (Gitai *et al.,* 2013) states there are no signs that humanity is prepared to adapt itself to such change in the average global temperature. The report goes on to say that should that temperature be attained it will be difficult to avoid the prospect of a temperature rise of 6ºC by the beginning of the next century with an increase in sea level somewhere between 50 centimeters and one meter. The results of the 5th IPCC Report (2014) and the work of the global consultancy PwC (2013) are along the same lines. If that is the case, however, where does the tipping point lie?

It can be found in the fact that climate change has stopped being fundamentally an environmental or ecological concern and begun to a decisive factor in the calculations of the most important global economic actors.

That change of perception translates into the idea of **unburnable carbon**.[2] A recent HSBC reported cited by Gilding (2013) shows that if the carbon contained in the coal, petroleum and gas deposits owned by the largest European petroleum corporations (BP, Shell, Statoil, ENI and Total) were **not** to be burned they would lose from 40 to 60% of their expected revenues. That is what the experts are calling the **carbon bubble**. It is a bubble insofar as the corporations assets are artificially inflated: the increase in their prices do not correspond to any real possibility of cashing on its supposed value.

The calculation that originated the HSBC assessment is based on an article published in Nature (Mainhausen *et al*, 2009) that basically states the following: if humanity opts to have a 50% chance of not elevating the global average temperature more than two degrees from now to 2100, greenhouse gas emissions for the period 2000 to 2050 (what experts call the **carbon budget**) must not total more than 1,440 gigatons.

The carbon budget concept is fundamental; instead of indicating the limits of available fossil fuels, it identifies the point beyond which burning carbon threatens the atmosphere and consequently the very conditions that allow for the reproduction of life itself. It is an indispensable complement to the **carbon space** idea. It is not just a question of what the known fossil assets are but rather what possibility exists of converting those assets into wealth without destroying the foundations of social life.

Of the 1,440 gigatons of CO_2e (the set of greenhouse gases converted into carbon equivalent) that could be burned by 2050 while still maintaining the limit of a 2 degree increase in temperature, since the year 2000 no less than 400 Gt CO_2e have already been used. That means one quarter of the carbon budget for five decades has been spent in a little over ten years. So there only remains around 1,000 Gt CO_2e if the limit of two degrees is to be respected. Given that the known reserves of fossil fuels are 2,860 Gt CO_2e, it means that only one third of that potential wealth can actually be turned into a real utility (and economic gain), if the ethical and political option of avoiding any increase beyond two degrees is respected.

Obviously, for companies whose main strategy consists in exploiting fossil fuels that result is devastating. **Those companies are founded on assets that can only be converted into wealth if they destroy the climate system** and with it the conditions that allowed civilization, such as we have known it for the last ten thousand years to emerge (Rockstrom and Klum, 2012). The experts' calculations show that if emissions continue at the level they are today, the carbon budget, which should cover the period up to 2100, will be spent out in 2034, that is, in twenty years time (PwC, 2013). To keep within the budget limits compatible with the two degree rise, the carbon intensity in the goods and services supply should by now have dropped 6% and then continue to go down at that rate every year through to 2050. In other words, each unit of value that makes up the global economy should have been produced in 2013 with 6% less greenhouse gas emissions than in 2012 and that should have been repeated in 2014 in comparison with 2013 and so on, successively.

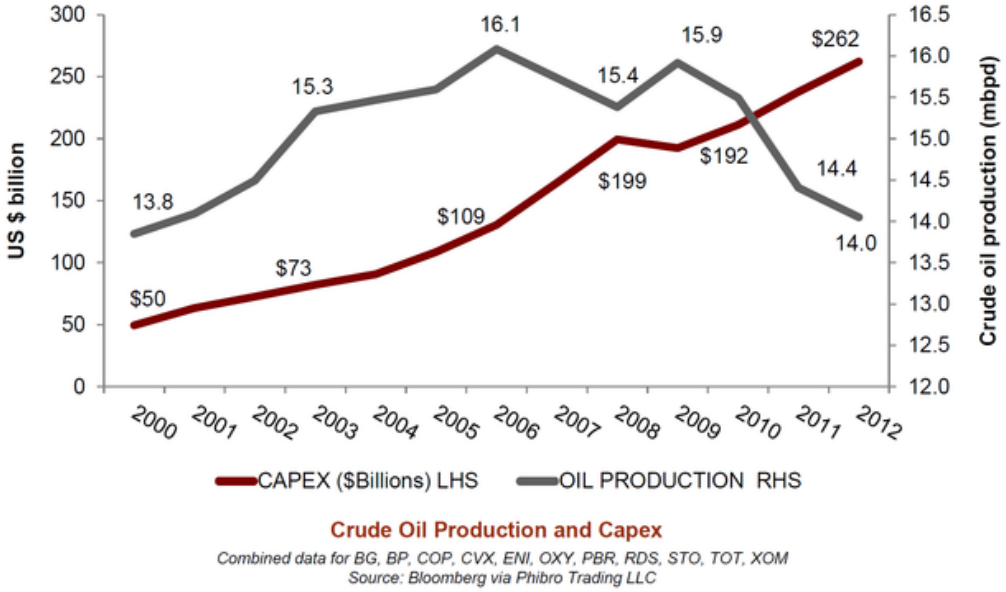
Actually, largely thanks to the American shale gas there was a reduction but it was a mere 0.7%, eight times smaller than what was needed. Even if the current decarbonization rate were globally multiplied by two it would lead to a temperature rise prospect of four degrees by the end of the 21st century. Obviously, every time the decarbonization goal fails to be achieved, in the following year the target must be higher. In 2008 the PwC calculated that the reduction in carbon intensity in the global economy needed to be 3.5% a year. Given that the results have always fallen far short of the target, today we are faced with the need to reduce the carbon intensity in the global economy by 6% a year. To give a clearer idea of what that means, achieving that target demands that we reduce that carbon intensity by 50% in the next ten years. By the year 2050 it needs to be one tenth of what it is today.

There is another factor, however, that helps to explain the carbon bubble: while shale gas has made it possible for American emissions to go down in the last few years,[i] many experts estimate that the energy efficiency of exploiting it is clearly in decline. Jeremy Leget (2014) says that the search for petroleum in the United States is a bit like the race

organized by Lewis Carrol's Red Queen: the 25 thousand wells that currently exist in the USA produce the equivalent of what the 5 thousand wells that existed in the year 2000 produced. His book predicts that many of the investments that have gone ahead in this area are liable to melt away; and much sooner than could be imagined.

Chris Neder (2013) makes an observation in the same vein and based on information published in the Wall Street Journal. All the US$ 500 billion invested in new projects during the last five years were insufficient to increase petroleum production in the USA. Since 2010, Chevron's costs have increased by no less than 56%. The graph below was extracted by Nelder from a presentation made by Steven Kopitz at the University of Columbia's Center on Global Energy Policy (http://energypolicy.columbia.edu/events-calendar/global-oil-market-forecasting-main-approaches-key-drivers) and shows the contrast between the increase in investments in fossil fuels and the decline in crude oil production.

Figure 1:
Capital expenditures of publicly traded companies and oil production in the USA



Faucon (2014) shows that producing shale oil in the USA costs 14 times more than the conventional extraction in the Middle East. Enven thought, this exploitation is going ahead. Furthermore, a new petroleum frontier is opening up for global corporations precisely in those places which, up until quite recently, exercised the most rigid control over their presence: Mexico, Iran, Iraq, Algeria, Libya and (although

not mentioned in Faucon's article) Brazil itself. "These countries are trying to exploit their reserves more, offering generous terms in a bid to attract the assistance of the big western oil corporations". There are promises are of gigantic financial gains, says the Wall Street Journal.

These new frontiers of exploitation in no way attenuate the impressive contrast between the size of the investments made in non-conventional forms of fossil exploitation and the precarious economic gains obtained from that exploitation. Journalist Ambrose Evans-Pritchard (2014) considers that the fossil fuels have a good chance of being at the epicenter of the next global financial crisis. He refers not only to the work of the Carbon Tracker Initiative but also to the global consultants Kepler Chevreux (2014) report according to which, should there be an international agreement arrived at to preserve the climate system, the losses accruing to the fossil giants will be to the order of US$ 28 trillion of which US$19.3 trillion will be lost by the petroleum sector.

Those are just some of the more important signs that the search for energy based on fossil fuels, which dominated the energy services supply throughout the 20th century, may well be running out of time. It is a course that leads to the destruction of the climate system, humanity's most precious common asset. Also, the economic viability of this course is becoming increasingly problematic in the light of soaring exploitation costs even before the eventual imposition of an international tax on carbon emissions is adopted. It is worth remembering the growing adhesion in the corporate world itself to the notion that carbono emissions should have a price and that will make access to the services that this form of energy production provided so cheaply during the 20th century even less feasible (Azevedo, 2014)

Added to this scenario in which the destructive effects of fossil fuel use, the soaring costs of production and the consequent withdrawal of the large-scale global investors[ii] from this sector become glaringly apparent is the second and most important tipping point, which will make the struggle for a more egalitarian occupation of the remaining carbon space make less and less sense. What is involved is the progress not only of renewable energies but also of the prospect that their most accessible and democratized forms will be dominant within a few years. A broad social coalition is currently forming in that direction and, in addition to activists and various governments, it involves segments of the corporate world as well.

Modern renewable energies, the future has already arrived

Recent progress in the field of renewable energies is surpassing the most optimistic expectations: that is the second tipping point mentioned by Paul Gilding and together with the carbon bubble and the increasing difficulty in realizing the value of the assets represented by investments in fossil fuels, it is opening the way for the digital revolution to transform energy sources and offering technical conditions to make the advance of social collaboration feasible to an unprecedented extent.

It has nothing to do with hydroelectricity, where technical progress has been quite modest and whose growth possibilities are limited by the uncertainties surrounding the

availability of water and by the demands to maintain the ecosystems that the construction of huge hydroelectric plants threatens. Furthermore, the social-environmental harm and damage that dams cause goes beyond the destruction of fragile ecosystems and concerns also the interruption of the free flows of the rivers[3]. Even those who emphasize the positive role of dams in controlling flooding, opening up irrigation possibilities and producing clean electricity are now showing concern with the recent growth in their numbers. One of the most respected specialists in this field, anthropologist Michael Cernea, does not hesitate to use the expression "a tsunami of dams" when referring to the rhythm of new dam constructions in Asia, Africa and Latin America[4]. In the Amazon there are 412 hydroelectric dams planned or already under construction, as the important report produced by Little (2014) shows.

In spite of the fact that over 69% of its energy comes from hydropower sources (up until a short time ago it was 90%), Brazil is experiencing a virtual rationing due to the shortage of water in its major reservoirs. Those that supply a significant part of São Paulo, for example, were down to less than 9% of their reserve at the beginning of May 2014. In addition, the costs of building hydroelectric dams and plants have been systematically higher than the forecasts, which has meant that the presence of the private sector in such ventures actually depends on huge amounts of public funds. Thayer Scuddr, whom the New York Times (Leslie, 2014) describes as "the world's leading authority on the impacts of dams on poverty" has come to the conclusion, after 58 years of working with this theme, that the great dams do not bring in a return proportional to their costs and those that have been planned most recently are going to have disastrous social, economic and environmental consequences. The New York Times article (Leslie, 2014) cites a far-reaching survey conducted by Oxford University researchers targeting 245 dams constructed between 1934 and 2007. According to their study, planners are always excessively optimistic and, as a result, the real costs of the constructions are almost always double what was imagined and indeed, they are the most costly of all modern infrastructure projects. On average the construction period exceeds the schedule by 44%. Belo Monte is mentioned as one of the various examples around the world of initiatives whose costs ended up being far higher than was originally foreseen and whose profitability is unlikely to make the venture economically viable.

And let us not forget to mention the attempts to undermine the rights of indigenous peoples and the integrity of their areas to make way for the construction of hydroelectric plants.

In spite of hydroelectricity's great contribution to the energy matrix in various parts of the world, its growth is inelastic, conflict-ridden and increasingly costly Also this is not a sector in which the most important technological advances of the digital era are being applied. That is why, when the subject is modern renewable energies, the focus is on solar, wind, biomass and geothermal energy. It is also important to mention the question of batteries, which up until recently were one of the great limitations to the expansion of the renewable energies: they are still costly and bulky and with limited capacity to attenuate the intermittency of solar and wind energy sources. That situation too is changing at dizzying speed.

In this section information is provided that corroborates those changes The carbon bubble, the rising costs of fossil sources and the growing difficulties to expand the hydroelectricity offer would lead us to believe in a scenario of increasing energy scarcity and therefore an ever greater dispute to occupy the remaining carbon space. Progress with renewable energies and their decentralization (however incipient) at least suggest the hypothesis that fighting to enable the developing countries to occupy more carbon space means consolidating a movement contrary to the direction being indicated by current technical possibilities and to the emancipating prospects that are emerging with social collaboration in energy production and use. Let us examine some important relevant information.

The point of departure is paradoxical: currently modern renewable energy sources contribute less than 3% of the global energy matrix (Ayres and Ayres, 2010). That includes non conventional forms of biomass like ethanol for internal combustion engines but it excludes archaic forms of biomass like burning firewood, coal or dung for cooking and heating purposes. How can we rest our hopes on techniques whose expression, up until now, has been so modest? After all when we are speaking of wind and solar energy, intermittent supply and high costs are the associated terms and up until a little time ago they appeared to be insuperable problems. That being so, how can we talk about a turning point represented precisely by those very energies and what could their consequences be in regard to overcoming the impasses in the climate negotiations?

The answer has its beginnings in the mathematical concept of exponential growth, as one of Americas' most important inventors, Ray Kurzweil (Miller, 2011) has shown. In the same way as occurs with Moore's law[iii], nanotechnology, which is responsible for the innovation in the solar energy field is progressing exponentially.

In the United States the percentage of the energy offer originating from modern renewable sources (that is solar, wind, geothermal and biomass with the first two clearly predominant) doubled from 2008 to 2012, reaching above 6% of that country's energy matrix. In 2012, solar panel prices fell by 65% in comparison with the prices in the preceding eighteen months. David Crane and Robert Kennedy Jr. (2012) estimate that decline as having been even greater: 80% between 2008 and 2012. As a result, the price of a kilowatt generated by solar panels, which was five dollars in 2008, fell to US$ 0.50 in 2013[iv]. There are already twenty American states in which solar energy competes advantageously with energy from conventional sources, according to Crane and Kennedy (2012). Between 2009 and 2013 electricity production by solar panels in the USA increased at the rate of 63.2% **a year** (MacDonald, 2013). In 2013 the amount of energy generated by photovoltaic panels in the USA was no less than fifteen times the amount that was generated in 2008 (Environmental Leader, 2014). According to Ray Kurzweil (Miller, 2011), in the last twenty years the total solar energy offer has been doubling every two years. If it continues to do that over the next sixteen years it will mean that 100% of the energy offer on the planet could be of solar origin. "And even then" he says "we will only be using on ten thousandth part of the total energy that the sun irradiates the Earth with".

Azevedo (2012) shows that such growth is not restricted to the USA nor to solar energy alone. Actually wind generated electricity is the fastest growing source in the

world followed by solar energy. The global installed capacity for wind energy generation increased by 30 GW in 2011. In that same year, hydroelectricity only increased 12 GW. In the case of solar energy, with just half of Brazil's insolation Germany today has an installed capacity of 32GW, the equivalent of 1/3 of all generating capacity installed in Brazil, including hydroelectricity and, as Jeremy Rifkin (2014) has pointed out, no less than 70% of renewable energies in Germany correspond to distributed energy, installed in millions of homes, offices, factories and farms. Around 85% of Germany's solar energy capacity has been installed since 2008 in the light of its determination to attain the mark of 35GW installed generating capacity in 2015 (and everything indicates that they will surpass that level and get up to 45GW). In the world at large, installed solar energy capacity should stand at somewhere between 207 and 342 GW. In Germany installed capacity for solar generation of one kilowatt cost 3.6 thousand euros in 2011 but in 2013 it was down to 1,000, a reduction of 70% (Seager, 2013).

That progress is based on technological innovations that affect different aspects of renewable energies and is expressed, at least partially, by the number of patents being registered for this area. In the USA, the number of renewable energy-related patents being registered each year was 200 in 2000 but after 2009 it went up to one thousand a year. Patents related to fossil fuels, on the other hand, went from 100 to 300 a year. Solar and wind energy patents in the USA have been growing at a rate of 13% and 19% a year respectively since 2004; a rate higher than the one registered for semiconductors and digital communications (Kortenhorst, 2014).

Such advances are clearly reflected in the World Bank's new orientation that applies the United Nations' 2012 decision to work towards the goal of renewable energy for all (World Bank, 2013). In South Africa for example, wind and solar sourced energies are already cheaper than energy obtained using coal in spite of the wide availability of that fossil fuel in the country (Welz, 2013). The higher comparative cost of fossil fuels, hitherto considered unbeatable, can be explained by the impressive learning curve associated to the renewable sources. In the last twenty-five years wind turbine productivity has increased a hundredfold and the average capacity per turbine has been multiplied by no less than a thousand (Rifkin, 2014). That stimulates the exponential growth of wind energy. Its global supply grew at a rate of 30% **a year** in the period 1998 to 2007, which means production capacity doubled every two and a half years. Global Wind Energy Council figures show that in 2014 alone the global wind energy offer went up by 33% (GWEC, 2014).

Modern renewable energies are already threatening the functioning of the centralized energy networks because a growing proportion of their supply is coming from households and commercial establishments. As Sara Gutterman (2014) so aptly expressed it, "grid defection" is a terrain that was not foreseen in the scenarios of the conventional energy companies. What is intriguing is that the prospect of energy supply security now relies more on a sector which until quite recently was considered more unstable and intermittent than the conventional sector where costs are tending to rise and whose foundations for functioning are increasingly incompatible with sustainable development. The global financial services organization UBS has forecast that in the current decade electricity bills in Italy, Germany and Spain will drop by 20 to 30% as a result of increased

self-production. Conventional energy companies are likely to lose 50% of their profits before 2020. Furthermore, the advent of batteries capable of storing energy will compensate for the moments when winds drop or for the lack of sunshine at night.

One of the main obstacles to the expansion of solar energy use has always been the cost of installing the equipment, not only in financial terms but also in the transaction costs. That is now rapidly being overcome and all over the world companies are springing up that offer solar panel installation on buildings on a leasing basis, with the payment involved not being any greater than what the consumers would normally pay for their electricity bills. The installing company also takes responsibility for maintenance. SolarCity, owned by the innovative South African-born Canadian Elon Musk, recently introduced this business model in California, Arizona, New York and Oregon (Spross, 2014). Google is also adopting this new business model. In California, the 400% increase in household installation of solar panels in 2013 as compared to the previous year is a vivid expression of such progress[v]. According to the above mentioned UBS report the amortization period for such investments is from five to six years for commercial establishments and ten to eleven years for homes.

The recent declaration of the head of the USA's Federal Energy Regulatory Commission (FERC) Jon Wellinghoff also attracts attention: as soon as storing energy in batteries becomes commercially viable it will be "*game over*" for the traditional ways of generating. He predicts that solar energy will surpass wind energy converging in that with the already mentioned view of Ray Kurzveil. The secret of this new success lies in distributed energy generation.

It is important not to lose sight of the fact that the decentralized production of energy is part of a much broader set of phenomena that constitute the Third Industrial Revolution. While it is true that originally the digital media were concentrated in the area of knowledge and information, nowadays they are typified by three inseparable dimensions (Rifkin, 2014), the best known being the information internet which provides free access to a gigantic set of services which until quite recently had to be paid for. The information internet has already revolutionized the recording industry, the world encyclopedia publishers, of shows, the big newspapers and the world of scientific knowledge dissemination and exchange. In the last ten or fifteen years, two other internets have joined the information internet, namely, the energy internet and the logistics internet.

The energy internet does not merely consist of the extraordinary progress made in wind and solar-based energy production that have been cited above. It includes the fact it makes it increasingly possible for each household, each factory, each farm, not only to produce energy but also to supply it to the grid, thereby transforming today's energy consumers into veritable "prosumers" an expression increasingly used in studies on collaborative forms of consumption (Havas Worldwilde, 2014).

What is more important, however, is the connection between the energy internet and the internet of things, that is, the logistics internet. Objects themselves are increasingly connected in intelligent networks thereby transforming themselves not only into the bases for production and consumption but also into sources of information. Household appliances and even automobiles are able to use and store energy and

supply it to the grid.. Today there are more objects connected by digital devices than people: twelve billion devices in 2010 with an estimated increase to 25 billion by 2015 and 50 billion by 2020.

Elon Musk invested US$ 5 billion in a factory that promises to reduce the price of batteries by 50% by the end of the current decade. It must be remembered that, as part of his effort to reduce costs, Musk liberated his battery production patents in the hopes that other innovators take up what Tesla has already achieved as the starting point for other innovations. Many analysts are already viewing the automobile based on an internal combustion engine as being a completely outdated technology. The Rocky Mountain Institute's work in that field is by far the most important. Electric automobiles will be an important part of the decentralized system in which objects will be offering energy to the network.

In addition, the very way that objects (starting with the automobile) are used is going to undergo a rapid transformation. In the coming years the automobile will become a shared-use, highly connected, digital platform (KPMG, 2012). That which a mere ten years ago was seen as something that would only become economically viable in the second half of the 21st century will certainly be entering the market before the end of the present decade and will bring about fundamental changes in urban organization, in the insurance sector and in the consumers' own ambitions.

Two other important sources of energy that are neither fossil fuels nor hydroelectricity must be mentioned. The first is referred to in the same Amory Lovins (2014) article cited above: energy savings. The savings Americans have made by driving less and from the enhanced energy efficiency of automobiles since 2004 has enabled them to reduce oil imports by over 18%, which is more than the import reduction that can be attributed to the use of non conventional sources of petroleum. Lovins calls attention to the paucity of knowledge regarding the impacts of energy saving: "what is lacking in energy economics is a sufficiently powerful amplifier to make its important signals audible to the supply side, and so efficiency continues to be ignored and underestimated".

The second is still practically at the experimental stage but, nevertheless, highly promising. It is wireless energy transmission, a technique whose origins date back to Nicola Tesla's (1927) work but which is currently developing vigorously thanks to the alliance of nanotechnology and digital media.

Conclusions

What are the consequences of these innovations and tipping points that are set to make conventional forms of energy production in the contemporary world no longer viable? It could be argued that the technology involved may eventually have a strong impact in high and medium-income countries but that, for poor countries, they are so far out of reach that there is no reason to contemplate them in their immediate prospects. It is true that the digital divide[vi] is deep and wide in spite of the fact that the number inhabitants of the Planet that own cell phones recently surpassed the mark of three billion, two thirds of them in developing countries.

However, this is the point that should dominate the discussion and proposals for combating global warming: far more important than guaranteeing that low and medium-income countries enjoy the right to continue contributing (increasingly) to the destruction of the climate system is the challenge of endowing them with technical conditions that will make it feasible for them to advance in the digital revolution without having to pass through all the most predatory features that characterized the first and second industrial revolution.

Given that the transition is going to take place in a context where the high and medium-income countries will making use of equipment that emits high levels of greenhouse gases, then what needs to be done first is to tax those emissions and apply the bulk of the results to efforts to accelerate the decarbonization of the global economy in line with the proposal set out in the German Advisory Council on Global Change's important report (WBGU, 2009). When any examination is being made of the costs that stem from emissions and from the infrastructure associated to conventional forms of energy production, it is of fundamental importance to compare them with those that would be involved in the generalization of the digital economy in the contemporary world. What is happening in the telephone sector could be generalized not only to take in the world of energy but also the entire gamut of material production.

Perhaps the greatest obstacle, in that regard, is neither technical nor financial but instead, concentrated precisely in the constellation of vested interests associated to conventional forms of economic growth, beginning with the traditional forms of energy supply. The more investment is made in fossil fuel modes or predatory forms of hydroelectricity, the more unavoidable will be our dependence on the trajectory imposed by those technologies even under the guise of renovated versions such as the non conventional sources of petroleum, of which the Brazilian pre-salt exploitation is a prime example.

Concentrating political and diplomatic efforts at the G77+China on the right to occupy carbon space, in the name of equality, means consolidating the worst form of inequality, that which will condemn present and future generations to remaining far off from the goods, services and opportunities for collaboration that the digital revolution is beginning to propitiate.

Notes

[i] The counterpart to the supply of gas coming from non conventional sources in the USA was the drop in coal prices and its increasing use in various parts of the world, including Europe.

[ii] It is interesting to accompany the movement towards divestment which has now involved the bigger American universities and some of the larger global funds as one of the movement's leaders Bill McKibben (2014) has shown.

[iii] Basically Moore's Law states that the computing power of a an integrated circuit that can be purchased for a given monetary unit doubles every eighteen months. That has held true for the last fifty years. An important book by Brynjolfsson and McAfee (2014) sets out persuasive evidence that the progression will be maintained. It is one of the decisive factors behind the forecast that cars with no drivers will occupy an increasingly large share of automobile market induring the decade now in course.

[iv] (Naan, 2011) Estimates that the level S$ 0.50 will only be achieved in 2020. There are different calculation methods in the literature addressing this question but all are in agreement in regard to the exponential growth of the energy producing capacity of solar panels and the consequent fall in prices.

[v] http://pvsolarreport.com/blog/item/1288-american-solar-solution-record-setting-2013 Consulted on: 18/05/2014

[vi] http://www.internetworldstats.com/links10.htm, consulted on 18/05/2014

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INNOVATIONS TO DEMOCRATIZE ENERGY ACCESS WITHOUT BOOSTING EMISSIONS

Abstract: In its chapter on Mitigation, the 5th IPCC (2014) report recognizes that inequality among countries in the occupation of carbon space persists. Remediating that inequality is obviously important but it cannot be the strategic focus of the G77+China. It is more important to create conditions that will make it feasible for the recent extraordinary progress in the electricity generating capacity of renewable and decentralized sources to become massively available to developing countries. Bolstering fossil-based economies and constructing vulnerable, pernicious hydroelectric plants means prolonging the life of a form of access to energy which is being globally supplanted. For Latin America to persist in this route means compounding the re-primarization of its economies and drawing ever farther away from the knowledge society. The carbon bubble and the depreciation of conventional energy company assets together with the exponential progress in the decentralized generating capacity of renewable sources create unprecedented conditions for organically integrating the democratization of access to energy, the achievements of social and technical innovations, and respect for the ecosystems' limitations.

Key words: Climate change, inequalities, greenhouse gases, carbono budget, carbon bubble, renewable energies.

Resumo: O V relatório do IPCC (2014), em seu capítulo referente à Mitigação reconhece a permanência da desigualdade entre os países na ocupação do espaço carbono. Reverter esta desigualdade é, evidentemente, importante. Mas o foco estratégico do G77+China não pode ser este. O mais importante é criar as condições para que os extraordinários avanços recentes na capacidade de geração de energia elétrica de fontes renováveis e descentralizadas cheguem de maneira massiva aos países em desenvolvimento. Fortalecer as economias fósseis e construir hidrelétricas nocivas a ecossistemas preciosos e frágeis é perenizar um caminho de acesso à energia que, globalmente, está sendo superado. Para a América Latina, persistir neste caminho significa aprofundar a reprimarização de suas economias distanciando-as ainda mais da sociedade do conhecimento. A bolha de carbono, a depreciação dos ativos das empresas convencionais de energia, juntamente com o avanço exponencial na capacidade de geração descentralizada das renováveis abrem condições inéditas para que a democratização do acesso à energia, o avanço das inovações técnicas e sociais e o respeito aos limites ecossistêmicos estejam organicamente integrados.

Palavras-chave: mudanças climáticas, desigualdades, gases de efeito estufa, orçamento carbono, bolha de carbono, energias renováveis.

Resumen: El V informe del IPCC (2014), en su capítulo referente a la mitigación, reconoce la permanencia de la desigualdad entre los países que se disputan la ocupación del espacio carbono. Revertir esta situación es, evidentemente, importante. Sin embargo, el foco de la G77+China no puede ser éste. Lo más importante es crear las condiciones necesarias para que los extraordinarios avances recientes en la capacidad de generación de energía eléctrica proveniente de fuentes renovables y descentralizadas lleguen de forma masiva a los países en vías de desarrollo. Fortalecer las economías fósiles y construir hidroeléctricas nocivas para ecosistemas preciosos y frágiles es perennizar un camino de acceso a la energía que está siendo superado globalmente. Para América Latina, persistir en este camino significa profundizar la reprimarización de sus economías, distanciándolas todavía más de una sociedad de conocimiento. La burbuja de carbono, la desvalorización de los activos de las empresas convencionales de energía, junto con el avance exponencial de la capacidad de generación de renovables, abren condiciones inéditas para que la democratización del acesso a la energía, el avance de las innovaciones técnicas y sociales, y el respeto a los límites ecosistémicos estén orgánicamente integrados.

Palavras Clave: Cambio climático, desigualdades, gases de efecto invernadero, presupuesto carbono, burbuja de carbono, energias renovables