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Management in a + 4°C world

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Help!, John Lennon, 1965

Abstract: Even if some still deny the global warming phenomenon, for purely short-term political reasons, facts and figures are now numerous enough to be absolutely sure that the increase in temperature on the surface of the Earth will be several degrees at the end of the 21st century. The only unknown fact is exactly how big this rise will be. The range is between 3 and 4°C, and more and more climate scientists think that 4°C is more and more probable considering the measures which have not been taken and are still not taken. Consequently, this drastic change, unseen since man appeared on Earth, will have huge impacts on all walks of life for the environment in a broad sense and of course for mankind in social and economic terms. This study first examines what the climatic situation would be at the end of the 21st century in the light of the scientific evidence available. Then, in the hypothesis of a +4°C world, the social, economic and management consequences are investigated. Finally, in front of this never seen challenge, a number of solutions to cope with this +4°C world are examined and proposed. The conclusions are that huge changes are needed to build new economic and management models and practices. Otherwise, the outcome is simple enough; mankind will not be able to survive, at least as it has been known since the appearance of *homo sapiens*.

Type of paper: conceptual and prospective

Keywords: climate change, socio-economic impacts, management theories and practices, proposals for resilience and survival of mankind.

Introduction

In Johannesburg on 2 September 2002, Jacques Chirac, President of France, declared: “Our house is burning, and we are looking elsewhere”. That was twenty-five years ago. In 2015 in Paris, at the COP 21, 196 parties signed a legally binding international treaty on climate change to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels. To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030” (United Nations, Climate Change). That was ten years ago.

Our house is burning more than ever. The 1.5°C is already obsolete. The average temperature increase already reached +1.55°C, compared to the pre-industrial era, in 2024 (World Meteorological Organization), the target of increase for 2030 will not be reached (IPCC 2023). Even a 2°C rise has become unreachable (IPCC 2023). Neutral ‘carbonicity’ in 2050 is now sure to be out of reach in 2050. In any case, ‘carbon neutrality’ does not mean that the amount of carbon in the atmosphere is reduced, it just means that no extra carbon is let out in the atmosphere.

Temperature will tend to +4°C at the end of the century. Scenarios are already designed on such a basis (IPCC 2023; Plan national d’adaptation au changement climatique – National plan of adaptation to climate change – presented by Agnès Pannier-Runacher, French Minister for the Ecological Transition on 10 March 2025).

The world is on a course of self-destruction (Guterres A., 2022).

Economic and management principles and techniques followed for the last two centuries, are at the root of these changes and have led to an impasse (Martin J., Baccarani C., Brunetti F., 2024).

Unfortunately, in spite of much talk about it, few really effective actions are taken and some even clearly go against climate control such as US policies illustrated by the “Drill, Baby, Drill” slogan or corporate policies, for example BP’s abandonment of its renewable energies policy and investment in further oil and gas exploitation, so that carbon emissions continue and will continue to increase.

Whatever politicians, entrepreneurs and all brands of climate negationists say, the evolution of the environment means fundamental changes in social organization and life, economic and management theory and organization, that, willy-nilly, will take place. Consequently, new thinking and behaviours urgently need to be adopted.

The Global Challenge is eventually the survival of the human species, at least in the form that we know it now.

This demands a re-evaluation of what the business environment will be like with such a hypothesis (Part 1). Then, the question is raised of what can be done to face this new environment (Part 2).

PART 1: The environment in a + 4°C world

The environment in a world which is 4°C warmer than today will be radically different from what it is now.

The warming of the planet’s temperature will have of course climatic consequences but also, induced by the latter, economic and social consequences. It is these economic and social consequences that call for a different economic and management approach that will alter people’s and businesses’ way of life.

1.1 The increase in temperature

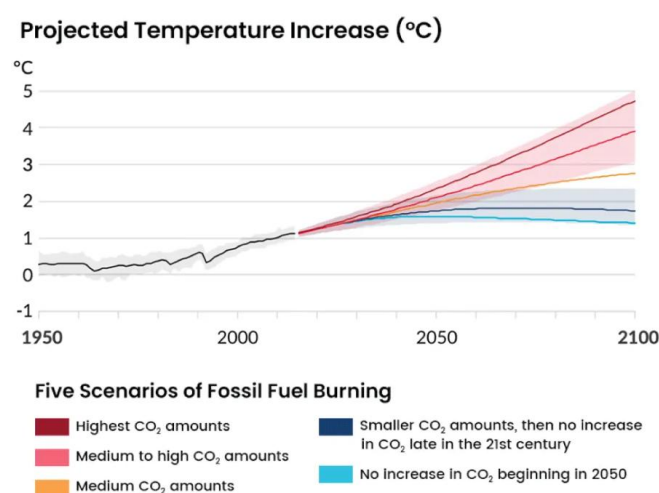
The increase in temperature on the surface of the planet Earth is not something new. Over geological eras it has constantly varied with periods of warmer climate and periods of colder

climate. What is fundamentally different between the present period labelled ‘Anthropocene’ and the previous ones is that climatic changes in pre-Anthropocene periods were natural phenomena whereas in the Anthropocene, change is overwhelmingly driven by human actions, with a unique characteristic which is that the change has taken place in an extremely short period in geological terms, that is in about 200 years. Since the appearance of the *homo sapiens*, roughly 300,000 years ago, there have been several climatic changes. But until a very recent period, about some 200 years ago, humans’ part in these changes was nil. Without going back to the origins of *homo sapiens*, the temperature was stable for about 10,000 years until the end of the 18th century and suddenly began to increase sharply at the turn of the 19th century (Osman, M.B., Tierney, J.E., Zhu, J. et al., 2021). In the absence of extraordinary natural phenomena during the period from around 1800 to today, simple logic tells us that human beings must be the source of the increase in temperature.

Scientific observations show that during the 1900-2020 period, the world’s surface air temperature increased by 1.1°C on average (IPCC, 2021-2023) and reached 1.5°C in 2024 (WMO). This increase is due to the burning of fossil fuels (coal, oil, gas) that releases huge quantities of CO₂ (carbon dioxide) and other ‘greenhouse gases’ into the atmosphere. Although such an increase may seem small to some, one must be aware that an increase of 0.1°C can have a significant impact on the planet.

From today to the year 2100, climate models predict that the Earth’s global temperature will likely rise to 4°C if greenhouse gas levels continue to rise at present levels. Without swift action, which is not taking place, to reduce greenhouse gas emissions, models show that the 1.5°C average increase ‘limit’ since pre-industrial times set at the COP 21, held in Paris, has become out of reach, and that the 2°C limit is doubtful. The 1.5°C average projected to be globally reached in 2030 was already reached on a single year basis in 2024, and an average 2°C increase is projected for 2050. The temperature will be, at best, about +3°C in 2100 and there is a reasonable probability that it could be +4°C.

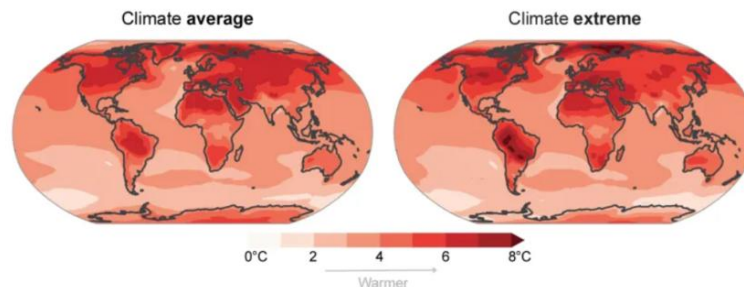
Fig. 1 – Projected temperature increase (°C)



Source: IPCC 2021 and 2023

The distribution of increases will vary significantly depending on the region of the world. Apparently paradoxically, the biggest increases will take place in the Arctic region.

Fig. 2 – Temperature changes

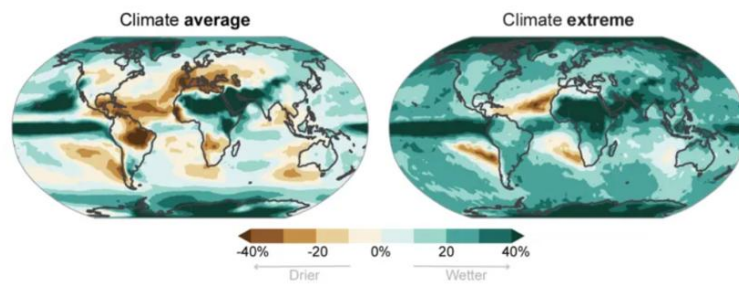


Source: IPCC 2021 & 2023

1.2 Precipitations changes

These changes in temperature affect precipitation due to a higher rate of evaporation. But there will be, and already is, more precipitation in some regions than others. “Global average precipitation can increase by 7% for each degree of warming”; “with a 2°C temperature increase, heavy rain events are expected to become 1.7 times more likely, and 14% more intense” (IPCC). The concentration of heavy rainfalls will increase the frequency and impact of floods, which can already be devastating (e.g. Pakistan in 2022, The Philippines every year, even Spain in 2024).

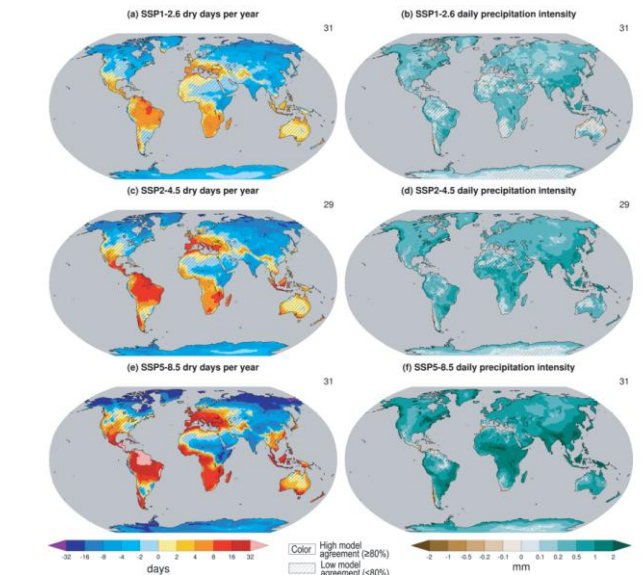
Fig. 3 – Precipitation changes



Source: IPCC 2021 and 2023

Warming also implies more periods of drought. In a number of places, more rain and more dryness are not contradictory but alternate, making the ‘liveability’ of the place even more difficult. Extreme agricultural droughts are projected to be 150 to 200% more likely at 2°C, and over 200% more likely at 4°C. Close to half a billion people in urban areas will suffer from water scarcity due to severe droughts (IPCC). A rise in temperature of 4° will increase wild fires by 50 to 70% letting out gigatons of carbon into the atmosphere, thus creating a vicious circle.

Fig. 4 – Changes in daily precipitation and dry days

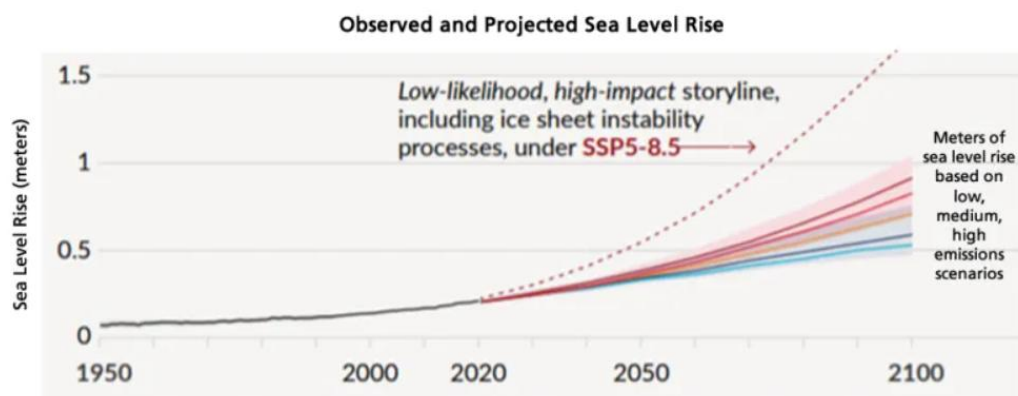


Source: ICPP 2021

1.3 Ocean and sea level rise

Another effect of warming caused by the gradual melting of glaciers and ice sheets, and the ocean water expansion round the world, is a rise in ocean and sea levels. According to IPCC, the sea level could rise from 50 cm to nearly 100 cm (and even 150 cm to 200 cm in case of an accelerating melting of glaciers and ice sheets) between 2020 and 2100.

Fig. 5 – Sea Level Rise scenarios 2020-2100



Observed (black line) and projected sea level rise through 2100, where the colored curves indicate sea level rise for different emissions scenarios.

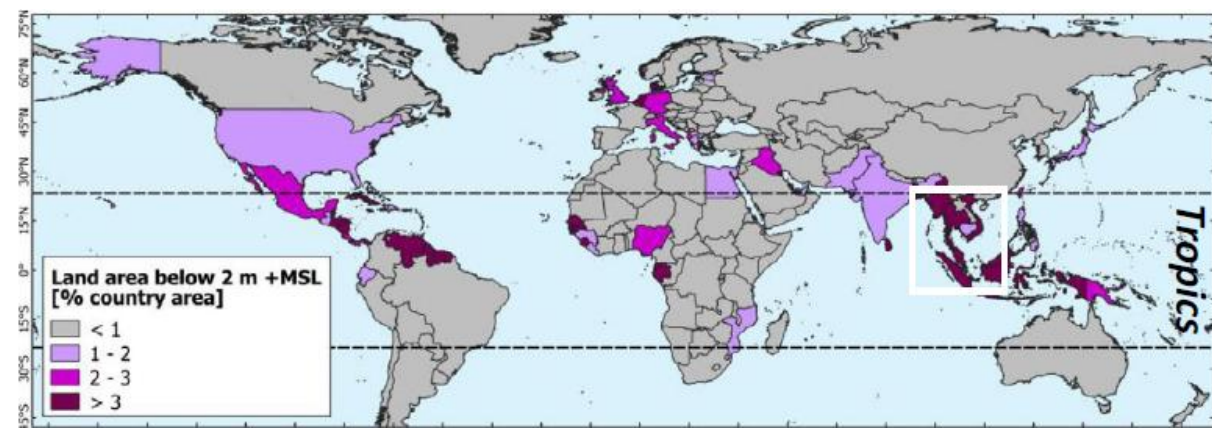
IPCC Sixth Assessment Report

Source: IPCC 6th Assessment Report 2021

According to IPCC, “since 1880, sea levels have risen about 0.10 to 0.20 meters (...) By the year 2050, models predict sea level will rise an additional 0.25 to 0.30 meters, and by 2100, without immediate reductions in greenhouse gas emissions, global sea level rise is expected to be on the order of 1.1 meters”. Even with a rapid reduction in GHGs, the accumulated greenhouse gases will cause a rise of about 60 cm. The estimate is that by 2050, about 1 bn people will be impacted; a figure that will, at least, double by 2100.

Geographical studies show that the regions most affected by sea level rise and consequently permanent or semi-permanent flooding are tropical lands between the Tropic of Cancer and the Equator, particularly in South-East Asia and of course in the Pacific Ocean, but parts of Europe (e.g. The Netherlands) or America (e.g. Florida or Louisiana) are far from being immune.

Fig. 6 – Land areas below 2 meters above sea level



Source: A. Hooijer, Netherlands Environmental Research Institute & R. Vernimmen, National University of Singapore, NATURE COMMUNICATIONS, 2021

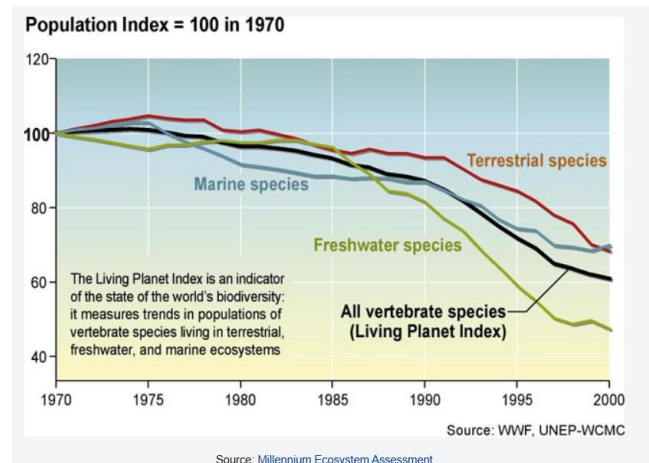
The most vulnerable areas are in Bangladesh, Thailand, Malaysia, Indonesia, Vietnam, The Philippines and parts of India where a sizeable part of the country, which is below 50 cm above sea-level, will be permanently semi-flooded by 2050 and permanently flooded by 2100. As for a good number of countries in the Pacific Ocean, which are at sea level, many of them will simply disappear. As these areas are densely populated, this phenomenon will lead to millions of deaths and millions of people that will be displaced. Some Pacific countries have already signed agreements with Australia or New Zealand to relocate their populations, for example the *Australia-Tuvalu Falepili Union Treaty* or *New Zealand Pacific Access Category* program with such countries as Fiji, Tonga, Tuvalu, and Kiribati (Higuchi E., 2019).

1.4 Loss of biodiversity

Warming, through the changes it causes to land and marine flora and fauna in the natural environment, together with activities of human beings such as deforestation or over-fishing, affect the biodiversity of the planet and provoke the extinction of a big number of species. Extinction of species, and appearance of new ones, is of course not a new phenomenon. It has taken place since the appearance of the first forms of life on Earth. Something like 1.2 million species have been recorded. But it is estimated that some 8.7 species are still to be discovered (McRae H., 2022). So, we will never know how many species there are, and how many are disappearing. Consequently, extreme caution is required when dealing with data about

biodiversity. According to research carried out by IPCC (2022), “in terrestrial ecosystems, 3 to 14% of species assessed will likely face very high risk of extinction at global warming levels of 1.5°C, increasing up to 39% at 4°C and to 48% at 5°C.” What is sure is that species are disappearing at a faster rate than ever, excluding extraordinary events, as the following population index shows:

Fig. 7 – Species population index



Source: Millennium Ecosystem Assessment

But we must be very cautious about the evolution biodiversity. The figures available, only giving an order of magnitude, only bear on identified species, which represent a small fraction of total species. Moreover, by definition, we know nothing about new species. And, do we really regret that we do not have dinosaurs wandering in our streets? Nevertheless, what is sure is that the evolution of the biodiversity alters ecological balances and then affects the human species.

1.5 Economic consequences

All the facets of climate change already have, and will increasingly have, economic consequences.

1.5.1 Agriculture

Agriculture is the first economic activity which is impacted by climate change. And it is probably the most critical one as the effects are irreversible, at least for a number of centuries to come.

The combination of extreme temperatures, with the ensuing droughts, extreme rainfalls, with the ensuing floods, and rising sea levels, with the ensuing flooding and salinization, are completely disturbing crop yields and cycles, in the ‘best’ cases, and making the growing of a number of crops impossible in a number of areas in the world, in the worst ones.

All scenarios about the relation between climate change and agricultural output show a reduction of output from 16% to 33% worldwide. A reduction of 30% is already seen in some zones, notably in Africa. Basic crops for the feeding of the human population, not to speak of the animal one, for example wheat, maize or rice, will suffer a drastic reduction of yields. For example, at around +4°C, maize yields will decrease by about 15 to 30% in North America,

Central America, the North of South America, central East Africa, South and East Asia, and by 35% and more in Central Asia. Only the southern tip of Africa and South America, and the South of Russia could enjoy a slight increase (3 to 10%) due to a warmer climate. The picture for fisheries yield is even bleaker. The 'maximum catch potential' is expected to diminish by 35% in the East Asia Ocean, the Pacific and along the coasts of Europe and Africa. The only place where there would be a significant increase, would be the Arctic, which would be largely free of ice the year round (IPCC, 2023). Climate change will particularly hit some countries, such as India, the most populous country in the world, with a reduction of output up to 56%, Pakistan up to 73%, Brazil up to 53%, Egypt, with a limited area of arable land, up 54%; these four countries totalling, today, nearly 2 bn people (i.e. 22% of the world population). The next big victim will be (sub-Saharan) Africa with a decrease that could reach 90% by the end of the 21st century according to some FAO estimates, which would add a good 1.2 bn people to the total. This means that agriculture will be wiped out in a number of central African countries South of the Sahara.

It is easy to conceive the social consequences that these changes will bring about.

1.5.2 Industry and services

Industry and services are not, like agriculture, by nature, affected by climate change. But they are indirectly impacted in their production processes and products delivered.

Climate change renders some aspects of the global supply chain impossible or very difficult. Even if the use of fossil fuels significantly decreases, they will not have disappeared at the end of the 21st century, which is one of the main reasons why the Earth's temperature will continue to go up. Even with a stabilization of CO₂, the temperature will be close to +2°C toward the end of the century (IPCC, 2023). If we can reasonably expect that coal will be completely phased out, oil and gas will still be there. In any case, to a lesser or bigger extent, production processes will have to use other sources of energy to operate. The impact of climate change on agriculture will, of course, disrupt the whole agro-industry. Some 'common' products today will disappear in some regions of the world. Some will reach unbearable costs for existing transformation processes. We already witness this phenomenon for coffee, whose price has more than tripled in 5 years, or cacao, whose price has quintupled in 5 years. Climate change, particularly because of precipitation and sea level rise, will make the relocation of many industrial plants a necessity and disrupt the supply chains, on a world level. This is already a reality; the floods in Thailand in 2011 stopped industrial operations at Toyota, Honda, Western Digital (hard disks) and a number of other companies (supplychaindigital.com). In a sort of ricochet effect, due to the internationalization of supply chains, the Honda assembly line in Swindon in England had to stop. Similarly, extreme heat waves will render production costs of some industries (e.g. pharmaceutical companies) 'un-economic' due to the cost of maintaining a stable rather low temperature in the production units.

Services may be thought of being rather immune from climate change. But they are also impacted notably through the rocketing use of information by means of the Internet, which is a big emitter of CO₂.

A cost approach can be appropriate to estimate the effect of changes in the environment on industrial and service activities.

At a macro-economic level, the value of production has been measured institutionally with the GDP since the 1930s when Simon Kuznets developed the concept, which had first been proposed by William Petty in the 1650s. Following the Bretton Woods Conference in 1944, GNP-GDP (as the name indicates GDP measures production 'at home', whereas GNP includes production abroad) became the standard way of measuring an economy.

GDP is the “addition of all productions’ total value for final use” (OECD). In other words, the GDP is the sum of consumption plus investment plus government expenditures plus net exports. This implies that all types of activities, whether beneficial or detrimental, are taken into account. Michel Rocard, French Prime Minister in the 1990s, used to say that the more car accidents, the better for the GDP. Negative externalities are ignored, and this is the main reason why GDP is an irrelevant measure as regards environmental impacts. Indeed, we know that environmental costs are totally neglected in public and private accounting (Martin J., Baccarani C., Brunetti F., 2022; Martin J., Baccarani C., Brunetti F., 2024) as the concept and calculation of GDP is deeply engrained in the concept of *homo economicus*. The notion of “wellbeing” is totally absent (Stiglitz). Kuznets himself warned about the pitfalls of GDP: “Distinctions must be kept in mind between quantity and quality of growth, between costs and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what (Kuznets S., 1962).

If the environmental cost was integrated into the calculation, the picture would be quite different. An attempt has been made with the so called ‘carbon tax’. A (limited) number of countries apply it, but not the biggest emitters of CO₂, and this tax varies enormously across countries. There has been no agreement yet about a worldwide standard tax, and there will probably be none.

At a micro-economic level, the situation is similar. Private accounting rules and practices ignore, except in some disputable roundabout ways, environmental costs as such. They are ‘transparent’ in the financial statements of a company. There are two IFRS standards dealing with environmental issues (IFRS S1 and IFRS S2). But, apart from the fact that their use is optional, their objective is to help ‘*primary users of general purpose financial reports*’ in making decisions about their provision, or not, of resources to the company. Nothing is integrated into the financial reports themselves.

There have been accounting systems, usually labelled ‘green’, that have tried to work out an ‘environmental’ accounting (cf. Schaltegger, S. & Burritt, R., 2000; Schaltegger S., Burritt R., Petersen H., 2003). However, they have been largely remained unheeded up to now. Politicians, and a majority of economists, desperately cling to the classic GDP. Whatever their beliefs, ‘the Earth’s warming caused by greenhouse gases emissions may well contribute to a lasting decrease in growth (Serfaty Ch., 2024).

1.6 Social consequences

Climate change with the resulting multiplication of extreme temperatures, droughts, precipitations, floods, and agricultural loss of yields will provoke social catastrophes and upheavals.

“Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change” (IPCC 2022).

People’s health is greatly at risk with rocketing respiratory disorders, particular because of high concentrations of aeroallergens (Potsdam Institute for Climate Impact Research). Cardiovascular disease mortality could increase by 18%, 47%, and 69% in the 2020s, 2050s, and 2080s (IPCC 2022).

Semi-permanent or permanent floodings will increase the epidemics of malaria, dengue and cholera. By 2050 only, more than a billion people located in low-lying cities and settlements will be at risk from coast-specific climate hazards (IPCC 2022), this figure could rise to 2 billion at the end of the 21st century.

The reduction in agricultural output because of extreme heats causing desertification will increase human mortality through malnutrition and famines, especially in Africa. At the same time, around 4 billion people will suffer from water scarcity at the end of the century. According

to IPCC, over 9 million climate-related deaths per year are projected by the end of the century (under a +4°C scenario).

All these consequences will provoke a huge (potential) displacement of populations, in the range of 3 to 4 billion people, which, obviously, cannot be coped with.

The picture is mind-boggling. “It’s difficult to see how we could accommodate 8 billion people (now 9 bn) or maybe even half of that” (Johan Rockström, Director of the Potsdam Institute for Climate Impact Research). “The problem today is that of the incompatibility between the way of living of the human species and the conditions that made this way of living possible” (Vioulac J., 2024).

So, can anything be done to somehow mitigate the consequences of a + 4°C world and avoid obliteration?

PART 2: Survival or obliteration

It can be now taken for granted, especially with the recent developments both at national levels with the policies of President Trump’s administration in the USA (*Drill, Baby, Drill*: BBC 16-02-2025) and the partial dismantling of the Green Deal in the EU (European Commission: The European Green Deal, 11.12.2019) and at corporate levels for example with BP’s as well as other companies’ reversal of strategy about fossil fuels (New York Times 26.2.2025), that the targets set for global warming will not be reached. It is not possible to know for sure what the increase in temperature will be by the end of the century, but a 3°C to 4°C increase scenario has become the most probable. And it must not be forgotten that, even if emissions of greenhouse gases completely stopped today (2025), the temperature would continue to increase due to phenomena of inertia in the environment (A multi-model mean gives about 80 years to halve an input of CO₂; F. Joos F. et al, 2013). After CO₂ emissions are reduced and atmospheric concentrations stabilize, surface air temperature continues to rise slowly for a century or more (IPCC). Thermal expansion of the ocean continues long after CO₂ emissions have been reduced, and melting of ice sheets continues to contribute to sea-level rise for many centuries, just like a cargo ship continues to sail for miles and miles when the engines are stopped.

Consequently, the world’s environment will be fundamentally different. Weather patterns will know a multiplication of extreme events within a context of global warming (see supra), demography will be altered with a levelling out of the world population around 10 billion people, which would be a relatively good thing, but far from what a +4°C world would be able to accommodate in decent social conditions (see supra 1.6), and the distribution of population will increase risks with a higher concentration in the most dangerous places for survival. Production patterns will dramatically change, beginning with agriculture but also with industrial products.

Therefore, the way management has been conceived almost since it was born at the time of the first Industrial Revolution, must be drastically overhauled in all its aspects.

At a practical level, the three traditional sectors of an economy (agriculture, industry, services) have to be re-thought: first agriculture, the most affected sector, as it is directly impacted by climate change and vital for the survival of all species, then industry and all that goes with it (production processes, supply chain management, products, marketing) have to re-invent themselves. Services, which, at first sight, may look less affected – but wrongly –, have to be deeply re-evaluated to foster those that really create value for people and eliminate those that use, that is waste, resources without creating any value. This could certainly be the most difficult part as services, being immaterial by nature, hence invisible, do not affect the minds of the people in the same way as material products.

Consumption as well has to play its part, since a change that wants to be effective cannot avoid involving those who buy, use and dispose of products and services. Sustainability is often

conceived as an issue and a challenge for businesses, but it is all too plain that unless customers change their consumption patterns, no truly impactful change can take place.

Companies can be regarded as the main actor in the process of change. By the way, it can be worth noting that at the end of the day, while both regulators and consumers can sometimes act according to a sustainability logic, companies are in the position of really driving change. As a matter of fact, politicians often struggle to change the rules and, when they succeed, this occurs usually late. Customers, at least the vast majority of them, in principle even possibly really green-oriented, are often affected by the well-known intention-behaviour gap. Companies, provided they embrace a new management approach, are not so inconclusive and slow as politicians and retain much more power, both economic and organizational, than consumers. So, companies – better, “virtuous” ones – can really be the agent of change and act as a pivot in the change process.

We will consider now the various aspects of management listed above and see what actions could be taken to cope with a + 4°C world.

2.1 Practical level actions

2.1.1 Agriculture

Agriculture will be, and already is, the first victim of climate change. Yields will be reduced by at least 15% to more than 30% worldwide, with sharp regional variations. The problem is not really a question of quantity as the present total production could feed about 1 bn more people at the current production (~2800 calories per day/person) and a good 25% more with a ‘normal’ diet of about, on average, 2200 calories. Considering that globally around 25% of food production is wasted along the whole supply chain (going up to nearly 50% in the case of the USA), current production could feed around 1.5 bn more people (data are extracted from the FAO). Even taking into account that some waste is inevitable, present agricultural production could well feed close to 12 bn people. And even taking into account the reduction in yields due to climate, a good 10 bn people could be fed reasonably. If the world population has stabilized, and probably declined (see above 1.6), by the end of the century, the problem is not a quantitative one.

The crux of the problem is twofold: the distribution of food and the diet.

First, from a general point of view in the world, there is more production where fewer people live and shortages where more people live. So, in terms of people’s wellbeing, the distribution chain is deficient. Second, diets vary enormously depending on countries (with a range of 1 to 5). In some countries (mainly North America, Europe, Australia-NZ, Gulf countries) the daily intake of calories is above, in a number of cases well above, the average production (~2800 calories per day/person). In others (mainly in Sub-Saharan Africa) it is below the average production, with pockets of endemic malnutrition.

Therefore, solutions to tackle the problem of populations’ nutrition in a + 4°C world are comparatively easy to find but not easy to implement as they demand a revolution in consuming habits and behaviours (see below § 2.2).

As for the production of foodstuffs, the first requirement is to grow crops which are adapted to higher temperatures and/or water shortages. Therefore, crops requiring the use of a lot of water, such as maize, sugar, rice, bananas should be limited and those able to grow with little water, such as sorghum, beans, peas, crucifers, olives and grapes (examples of crops come from FAO) should be encouraged. A proper mix has to be found as some crops can stand higher temperatures but need a lot of water, some crops can cope with higher temperatures and need little water, and others need lower temperatures and much water or lower temperatures and little water. Consequently, a migration of crops will take place depending on the new climate

conditions, creating a new agricultural map. New heat and/or water resistant crops can also be developed (it is already the case) either naturally by hybridization or artificially by genetic modification (which is also already the case). A particularly critical source of nutrition is the case of meat. First, when animals are fed with cereals, they are in competition with humans. Second, as they need a considerable amount of land, they are in competition with other agricultural produces. Third, they consume a lot of water; the production of 1 kg of meat requires between 5,000 and 20,000 litres of water depending on the animal. And last, they emit a lot of greenhouse gases. The only solution then is to drastically reduce the production of meat. The second requirement is to organize the distribution channels of food so that everyone can have a fair share of it, that is enough calories to live reasonably well. The situation at present contradicts this objective, is illogical and consequently economically inefficient.

The distribution pattern today is that for (too) many produces and products there are long supply chains that make no environmental sense and little economic sense, except for the benefit of a few intermediaries. There are a number of products for which the distance between the place of production and the place of consumption is not compressible. For example, the consumption of coffee in North Europe has to travel a long way from South America, Africa or Asia. Climate conditions will not change anything to that (except the price). But for a number of products, such long supply chains are absolutely not necessary. Does the wellbeing of people depend on having strawberries or cherries from Chile in England in the middle of the Winter? Let us wait for the English strawberry season in June and July, and enjoyment will certainly be greater. The costly transfer, in all terms, of a big number of products from one end of the planet to another does not contribute to the wellbeing of populations. Then we have two big types of distribution channels: local to local, and non-local to local (or the opposite, which is the same rationale).

Local to local means products are grown locally and consumed locally. The result is that supply chains are short and products are consumed when they are available, that is seasonally. Such short chains save transport and waste, hence cut GHGs emissions and of course costs.

Non-local to local (or the opposite) means products are consumed far from the place of production. This type of supply chain must be limited to products for which there is no alternative so as to limit adverse environmental impacts and control costs.

These patterns of production and distribution imply a 'revolution' in consuming habits that is certainly the biggest challenge (see § 2.2).

2.1.2 Industry and services

Industry can be understood in a broad sense referring to any economic activity, according to its etymology. It can also be understood in a narrow sense referring to the production of material products. We will use it here in its broad sense, especially as it has become more and more difficult to establish a borderline between the production of material products and immaterial ones, known as services. A number of features apply both to material and immaterial products. However, as services, especially in the age of digitalization, present specific characteristics, we will consider them at the end of this section.

As is well known, any production process is the transformation of inputs into outputs, which aims at creating value all along the supply chain. Let us then travel along this supply chain focusing on the key elements to address the survival issue in a +4°C world.

Primary materials

Everything starts with the use of some raw materials, which it would probably more apt to call primary materials. Until today the materials used, which produce energy in a direct or indirect way, have been non-renewable ones, in the timeframe of mankind. This means that once they have been extracted and processed, the residual value, as we say in accounting, is equal to zero.

So, in a sort of paradoxical way, they create value by losing their value. The best known are fossil fuels (oil and gas) of course as they are major creators of greenhouse gases (see Part 1). But any ore is non-renewable. From our perspective, we can also mention all the so-called rare earth elements (the use of the adjective rare is significant) which comprise 17 metallic elements which are critical for the digital 'revolution'. This implies that their supply is limited.

For fossil fuels, in all their guises, being the major source of greenhouse gases, which is the overwhelming reason for global warming, the inevitable solution is to phase them out. This has started, but there is still a long way to go. The share of electricity produced by renewable sources is just over 30% (International Energy Agency, 2024). The stock of electric cars is around 40m (IEA, 2024), the total world stock of cars is about 1.5 bn. Therefore, this means that the phasing out of fossil fuels just for cars will take decades and decades and will not happen in a foreseeable future, that is by the end of the 21st century. And it is not necessarily a bad thing for several reasons. First, the installation of renewable power units requires a lot of materials (steel, carbon fibres, concrete, cells, etc.) which are CO₂ emitting. Second, there are some uses where using renewable electricity generation is not technically feasible, for now at least, for example for aeroplanes and maritime transportation. In the case of cars, where some rushed decisions have been made, and partly reversed already, a global analysis of the supply chain still does not show a favourable carbon footprint. If China has become the biggest producer of electric cars, most of them are made resorting to industrial processes emitting a lot of CO₂. So, we must be prudent and reason in a logical way. The first thing to do is resort to a very classic management technique; identify where action can be the most efficient and start there. A simple Pareto diagram tells us that, and this has been done, but not followed by appropriate action. Industry and buildings are by far the biggest emitters of CO₂, action should be focussed on them. This is where the fastest and biggest reductions can take place. Air traffic emits around 4.5% of emissions and cars and vans about 10%. So, air traffic is not a priority plus the fact that there is no real alternative at present, and road vehicles are rather at the bottom of the list. The most effective action in the case of transport is to continue to improve technologies to reduce the consumption of petrol (gasoline), which in 40 years has been divided by about three. The second thing to do is to continue efforts to be more sober and reduce consumption (see § 2.2).

Transformation

The second main stage is the transformation of these primary materials, whatever their nature, to produce something that is different from their nature, a material product or an immaterial one or most of the time today a mix of material and immaterial. This transformation mobilizes the organization's resources, and exhausts them, to instil value into the product/service. Here again, there is the destruction of a type of value to create a new type of value.

The transformation part of the process is where the most energy consumption and hence CO₂ emissions take place. Industrial activities, in a broad sense (power generation leading the pack), account for 56% of GHG emissions (Statista 2025). But this is also where it is easier to substitute one CO₂ emitting energy source with another non-CO₂, or less CO₂ emitting energy. Industrial installations, rightly called plants are (material) 'fixed assets' in the literal sense. So, they are relatively easier to work on, and this work can be done on a continuing basis, as opposed to ships, trucks or aeroplanes. For example, in the steel industry, the technology used itself can cut carbon emissions. Blast furnaces produce 2.5 to 4 times as much CO₂ as electric furnaces, and 20 times as much as hydrogen powered ones. Then the source of electricity also has a big impact. If the electricity used is from a nuclear source, the emission of CO₂ gets close to zero (World Steel Association, 2024). The same approach can be adopted for many other heavy energy consuming industries (e.g. concrete). And, of course, moderation, particularly thanks to a reduction of waste, remains *de rigueur* in the use of energy.

The transformation part of the process also implies to re-engineer the supply chain. Since the development of globalization in the late 1970s, whose cost ignored environmental aspects, though they were already known, supply chains have been longer and longer with intricate networks of companies involved in the global production process, whose patterns do not make sense when environmental parameters are taken into account. We can take two emblematic examples.

The first one is for the production of one of the best-known products in the world, the Apple I-Phone. The principle governing the supply is written at the back of the phone: 'Designed by Apple in California. Assembled in China', which is a big '*raccourci*'. But most consumers certainly do not pay heed to that. It has even disappeared in the latest versions of the product. A current I-Phone contains about 500 components, 90% of which are made outside the USA, in around 30 countries. It is interesting to note that the most valuable part of the product is made by Samsung, Apple's biggest competitor, a good example of 'coopetition'. Though Apple has been trying to streamline its supply chain these last years, the latter is still very fragmented. The result is that an I-Phone's carbon footprint is 72 kg of CO² (an I-Pad is 119 kg) (co2everything.com). You can fly about 5,000 km for the same CO² 'price'. And of course, this is not the end of the story. Every time such a device is tapped on, it creates a few grams of CO² (see below).

The second example is a brand of sport shoes, 'ON', which is getting more and more popular, mostly because it is endorsed by Roger Federer. Let us travel along the supply chain: the raw material comes (mainly) from India, it is treated in France, the shoe is made in Vietnam, it is distributed worldwide, and it is recycled in Italy. So, from raw material to recycling, the shoes, if sold in the EU, have travelled about 28,000 km. And 'ON' say they take care of the environment. What would it be if they did not? These two examples are not extraordinary but they are the norm for the huge majority of industrial products today. The pattern of the supply chain is the same whether you consider TV sets, washing machines, vacuum cleaners, refrigerators or cars.

If the environmental cost is taken into account when calculating the cost of managing such supply chains, it becomes clear that they cannot be cost efficient. That is the reason why they must be re-engineered. Like in the case of agriculture and food products' distribution, the first action to be taken is to shorten the chains as much as possible, first by avoiding the coming and going round the planet of components as the products are in progress and second by relocating activities closer to consumer markets. Of course, many will argue that it will hurt many people contributing to the production all along the way. But this is a fallacious argument when considering the cost of each type of component produced by each link in the chain, without taking into account environmental costs of course. For a standard cell phone sold \$ 450, the total production cost of its components is about \$ 185, some of them with a cost under \$ 10. Where is the flaw? Let us look at the situation from another angle. A pair of jeans sold \$ 22 in a Walmart branch, has a production cost of 90 cents, in 'decent' working conditions (interview of a factory owner in Bangladesh on 10.7.2013; npr.org). We can note on the way that the fabric, representing about 70% of the cost, comes from China. Obviously, the 'value added' does not go to the Bangladeshi workers, nor to the factory owners. Here again, where is the flaw?

In a + 4°C world, such a structure of supply chain will no longer be possible. Therefore, not only the length, and irrationality, of the supply chain needs to be addressed, but the whole production process, leading to the output which is sold to the 'final' consumer.

As regards what could, wrongly, be called pure services, the situation is trickier as most people do not realize the reality of this situation. In the era of digitalization, without judging its relevance, but taking it as a fact, companies, groups and individuals must be aware of its cost in environmental terms. Internet use accounts for around 5% of GHGs emissions, more than air traffic, and keeps on growing at a much faster rate than air traffic. Actually, if air traffic

emissions increase in absolute terms, they tend to diminish in relative terms. This is not the case for the internet. It is estimated that the average Internet user consumes 3,230 hours of digital content per year (730 hours of web surfing, 894 hours of social media, 1,399 hours of video and music streaming, and 207 hours of video conferencing) (Istrate R., Tulus V., Grass R., Vanbever L., Stark W., Guillén-Gosalbez, 2024.) Obviously strong action will have to be taken to control this rampant negative effect of internet use. Decarbonating the Internet will not be enough. The Internet not only uses a lot of energy but also a big number of 'rare earths'. It has also been demonstrated that intensive Internet use harms users' health (vision, cardio-vascular diseases, diabetes, obesity, WHO) notably mental health (Višnjić A., Kők K., Terzić-Šupić Z., Stanković M., 2024). Therefore, there seems to be no other way of mitigating negative impacts than to act, in one way or another, in an authoritative way. The so-called 'social media', which are anything but social, and which produce overwhelmingly noise and not information, and represent around 30% of internet use and a big part of streaming representing about 44%, will simply have to be banned. The best way to do it is most probably to make users pay for their use with high rates going beyond carbon compensation. Every economist knows that people abuse something apparently free and when it becomes paying, they stop using it or adjust their consumption to a real need.

There is one service which has come to the forefront of the public debate these last years; the case of Artificial Intelligence (AI). The idea of AI is not a new one, it was first aired by Alan Turing in the 1950s. Since then, AI has known ups and downs to the point of almost disappearing of the landscape at the end of the 20th century (Martin J., Baccarani C., 2022). But recently there has been a strong revival owing to renewed approaches and above all the possibility to build huge data bases hosted in big data centres. Our purpose here is not discuss the merits or perils of AI, but to look at the phenomenon from our environmental point of view. The creation and use of these data centres consume an enormous quantity of energy. At first sight, numbers are not mind boggling. At present (2024) the electricity consumption of data centres in the world is about 1% of global electricity consumption. But, in the light of planned investments (the global AI market, valued at over € 130 billion in 2023, is expected to grow up to nearly € 1.9 trillion by 2030 – Statista 2025), it is growing at a rate which is close to exponential, following a sort of Moore's Law. But a characteristic of data centres is that they are clustered in a small number of places (USA, China, European Union) where the electricity consumption is nearing 4%, with some extremes like Ireland where it is over 20%, already putting a stress on electricity grids. (Spencer T., Singh S.: What the data centre and AI boom could mean for the energy sector, 18.10.2024, International Energy Agency). Therefore, by reason of the electricity hunger of data centers, the uses that will be made of AI will be a critical issue as "some (AI) approaches consume significantly more energy than others" (Spencer T., Singh S., 2024). From an environmental point of view more electricity means more CO² emissions. Today, AI carbon emissions are already equivalent to the entire airline industry emissions (MIT). So, it seems that the (planned and expected) development of AI is not sustainable, as electricity will become relatively rarer and very costly. The logic then is that, whatever the discourses of entrepreneurs and a good number of politicians, the development of AI, like all Internet uses (see above), will have to be curbed. It would be preposterous to give *the* solutions for the end of the 21st century in a +4°C world, but some mix of technology, pricing and reasonable use (already today, a good part of the use of AI is pure waste), like for everything else, will have to be found.

2.2 Consumption

The outcome of the transformation is the output of the production process, that is the product/service. In theory, the value that has been instilled in the product/service during the

transformation should be transferred to the customer/consumer. But we will see that this is not the case. And, when the product/service has been consumed (i.e. burnt), it loses its value which becomes zero.

First, when the product is passed on to the customer/consumer, there may be a loss of value due to defects in the products. This loss has been addressed for decades thanks to Quality Management techniques, which have been quite successful in this respect (Martin J., Baccarani C., Brunetti F., 2025). However, there are still some failures, notably because of the insidious impact of ‘programmed obsolescence’, which must definitively be done away with. So, the use of QM must be focused on durability and sustainability, which have not been central to it until very recently (Martin J., Baccarani C., Brunetti F., 2025).

There is also a loss of value due to the under-utilization of the product. This raises the issue of ‘consumerism’. Customers are conned into the belief that consuming more is better (Martin J., Baccarani C., Brunetti F., 2025). Such a behaviour is one of the consequences of the application of the concept of *homo economicus* (Martin J. 2023; Martin J., Baccarani C. 2025; Pope Francis, 2015). False needs are created by marketers in order just to feed the GDP, disregarding all negative externalities. So, moderation and sobriety will have to be the rule.

There is also a big loss of value, in some cases 100% as some products are jettisoned without being ever used, due to waste. Just one example illustrates the extent of the problem. About 1/5 of the food available to consumers is wasted (UNEP Food Waste Index 2024), and this is only part of the picture (see above about agriculture). And the same goes for a host of other products. It suffices to visit a dump to be convinced of the amount of waste.

There will inevitably always be refuse from production. This refuse can first be limited at the beginning of the production process by designing the product so that it will generate as little refuse as possible – this is rather well under way for a number of products. Second, this refuse must be recycled in new products – this is also now rather well under way. The object of recycling must not only be the extraction of some residual value integrated into other products, but also the creation of new value according to the idea of ‘upcycling’ so that the residual value will increase when integrated into a new product (McDonough W., Braungart M., 2013).

Consequently, as regards foodstuffs, consumers, particularly in countries where the intake of calories is way higher than what is required for a healthy life, will have to reduce the quantity of food they eat and strive to limit unavoidable waste to a minimum, making way for a more egalitarian distribution of food stuffs available. They will also have to renounce consuming products which are not seasonally readily available, thus reducing the strain on the environment. In a + 4°C world, this will be unavoidable, voluntarily or not. As the saying goes: “Beggars can’t be choosers”.

The same goes with industrial products. The 3 Rs (repair, reuse, recycle) must be the rule. The pooling and sharing of some products, something which is already done on a limited scale, can help mitigate environmental impacts. Technologies can help but it is mainly through changing living habits that it will be possible to cope with this + 4°C world. For example, no sophisticated maths is needed to understand that, if you switch off a light when a room is unoccupied or some electric device when it is not in use, you consume less energy, without affecting the wellbeing of people. Examples like this abound, with consumers often not being aware of it.

In a nutshell, economic activities will only remain possible if the concept of circular economy is fully developed, taking into account all the parameters, economic ones of course, but above all social and environmental ones.

All these things considered, it should be clear enough that, in order to achieve an acceptable state of environmental safety, consumers themselves should act properly. And “acting properly”, as illusory as it may seem, means abandoning a way of living that is deeply centered

on quantity, a certain conception of quality, a plethora choice and (supposed) innovativeness of products. As it is shaped today, the consumption landscape in the so-called advanced economies is characterized by huge quantities, unprecedented levels of quality, ever-growing assortments and constant renewal of products. But this is not a natural state of affairs, it is a phenomenon which only appeared after the Second World War (Trentmann, 2016). So, as people got accustomed to an astonishing abundance of everything, available either in the overstocked shelves of supermarkets or in the infinite e-shop catalogs, they may shift towards a different way of relating with consumption.

It is probably true that a culture of ‘more’ is definitely ingrained in the human being (at least in the western world): the Olympic Games – which certainly were born in a non-consumerist society – are based on the “citius, altius, fortius” motto, signifying the human aspiration to improve and to grow bigger in every field of activity. And, if objects came to occupy such a space in people’s life, it probably means that they are really able to address a deep need of human beings.

So, in the consumption and economic realm, moderation, sobriety, frugality, detachment from goods, de-growth are now words evoking renouncement, sadness, poverty, to be kept well away from oneself and from the economy.

But, as Aristotle teaches us (Ἡθικὰ Νικομάχεια, Nichomachean Ethics), “in medio stat virtus” (virtue lies in the middle) according to St Thomas Aquinas’ phrasing, but also the Confucian 中庸 (zhong yong). The logic of “more” has made possible countless improvements in the human condition, and no one can or wants to deny it, but even good things can prove to be too much (Grant, Schwartz, 2011) and to the extent that this happens they can turn into bad ones.

In economic terms, whatever the disposable income a customer has, there is a saturation point in the consumption of a product (a decreasing marginal utility as was said in the 19th century). So, the theoretical curve of consumer satisfaction is similar to that of production. That is the main reason why marketing does not try to satisfy the needs of consumers, as is commonly believed, but tries to convince consumers that they have needs that they do not have, in order to increase production and comfort the companies’ strategy of never-ending growth. However, this quantitative approach has not proved that consumers are happier, it is often the opposite as they develop frustration, nor that they enjoy a greater wellbeing, here also the result is rather the opposite with all the negative consequences of a hyper-consumption on people’s health for example with sharp increases in diabetes, obesity and cardio-vascular diseases.

Perhaps we have come to a stage of our evolution when, after realizing the good and the bad of materialism, we can serenely reduce consumption and/or appreciate a more nuanced attitude towards the material aspect of life, in balance with the environmental capacity of the planet. After all, examples in this direction, such as Slow Life and/or Voluntary Simplicity movements, are already available. Not to mention Gen Z, in relation to which many researches show that young people are much less interested in material consumption than their parents or elders.

Obviously, a transformation of this kind is certainly easier said than done, especially on a large scale, but it is not impossible. And, in the end, it does not necessarily imply a worsening of living conditions but – probably surprisingly only if it is looked at with the same attitude as today – it could result in a more meaningful and satisfying existence.

2.3 The need for a new management and new strategy

Each and every facet in companies’ management in a + 4°C environment will have to be drastically reconsidered, and this must start now, to avert a ‘collective suicide pact’ (Guterres A., 2022). And, as it has been said before, this is especially important, because companies are not only powerful organizations on their part but, lying at the meso-level, they are able to influence both politics upward and consumers downward.

There already are some encouraging signs here and there with companies engaged in a management philosophy that breaks away from the *homo economicus* tenets privileging in an overwhelming way the economic performance, in the classic sense, that is the belief in growth as the only strategy for improving people's standard of living and the related performance measures, with profit as the paramount measure of entrepreneurial success.

But there are also very bleak and discouraging signs as there is a revival in a number of countries, starting with the USA, of a negation of climate change and its consequences. The global result is that about none of the pledges made by the 195 signatory States at the COP 21 in Paris in 2015 will be achieved.

2.3.1 A new management, towards a company metamorphosis

In this section some new management principles, new strategies and new performance measures will be presented, in order to hopefully pave the way to the unescapable change that we, as a species, are confronted with.

What is needed to be done? Changing the paradigm of reference of decisional corporate processes moving away from the short term and the profit towards the long term and the wellbeing of all the subjects with which the enterprise interacts, which includes the natural environment, in the context in which the enterprise acts and for the future generations.

It is necessary to spread in the enterprise a "superordinate purpose" with respect to the interests of shareholders and other stakeholders; a purpose which restores the true meaning of an enterprise as an "institution built to last" and spreads prosperity through choices guided by economic rationality, coupled, however, with a social rationale linked with the enterprise being a living entity participating in the community in which it operates.

In the current context, and even more so in the future, this change would allow companies to be more competitive and, in this way, generate profits through the pursuit of individual, collective, and social well-being.

This path opens the way to a true metamorphosis of the enterprise, which takes the form of a business for goodness or a harmonious enterprise.

This 'harmonious enterprise' operates according to a model of humanistic enterprise (Pirson M., 2017; Martin J., Baccarani C., 2025). Economics, as advocated by Aristotle, was to be at the service of people. It is oriented towards the common good (Pope Francis, 2015). It has a long-term vision with a management keeping the memory of the past and the vision of the future, capable to act in "a present of the present" (i.e. now) in tune with "a present of the past" (i.e. memory) and "a present of the future" (i.e. dream) (St. Augustine). Internal and external relationships, actions and decisions are the reflection of "thinking about oneself through thinking about others" (Baccarani C., 2024).

Talking about harmony in a world that spreads and disseminates increasingly complex disharmonies in the relationships that characterize it, may seem completely out of place or, at most, acceptable from the point of view of proposals. However, perhaps the very conditions that characterize our time forcefully require the introduction of concepts that can be transformed into actions capable of governing the inevitable disharmonies that life disseminates along its path, and harmony is certainly one of them.

In this perspective, the enterprise appears like a collective work of art which develops itself around an idea, an entrepreneurial dream, and realizes itself thanks to the contribution of all those who participate in the project with roles which are to be interpreted on the basis of their competencies and their creativity at the rhythm of the change dictated by the environment. It is a vision that underlines the centrality of the people who, like in a theatrical work, paint with their thoughts and actions the collective performance that will be achieved in the interactions between them and the environment operating in synchrony according to their rhythm and

characteristics. From this point of view, the enterprise appears like a community of agents moving towards the desired end.

The enterprise is harmonious when it expresses consonance and resonance in the variety of the polyphonic relationships that it is made of and is in tune with ecosystems to which it belongs, synthesizing in itself the principles of economic, organizational, social and environmental sustainability.

The superordinate principle that guides it consists in a programmatic search of wellbeing for all the elements with which it interacts inside and outside the organization, including the environment and the future generations. This wellbeing unfolds on the basis of the needs of everyone with the intention of meeting the present needs, while permitting future generations to enjoy sufficient resources to be able to freely decide the quality of life they wish (Sen, 2009). The wellbeing is looked for by putting the people at the centre of the decisional process and proposing useful, functional, beautiful and sustainable goods and services and products according to the rules of the art.

The harmonious enterprise presents itself as a human creation for the generation of wellbeing (Csikszentmihalyi, 2004) placing its decision-making processes “here and now” with the memory of the past and in the vision of the future or, to put it in Normann’s words, it acts “here and now” as an “exile from the past and a visitor from the future”.

Among the vectors of change that support its evolution, it sees imagination, creativity, emotions, skills, and technology, through which it is able to face even unexpected changes by enhancing the capacity for improvisation that the organization is able to express, according to the theorization of Karl Weick.

It is a company where it is nice to work because the management understands the importance of work in people's lives and acts so that they find meaning in their presence in the organizations (Rebora, 2024). This situation leads them to love their work and to spontaneously give the best of themselves (Whyte, 1997), combining speed and slowness, time for action and thought, rationality and intuition.

The diversity that characterizes every organization opens up a diversity of values leaving an indelible mark on the harmonious enterprise: listening, beauty, dialogue, trust, kindness, play, rhythm, tenacity, and humility.

In this way, the harmonious enterprise embraces and expresses the competitiveness that allows it to achieve a profit, not pursued as an end but obtained from the generation and diffusion of well-being, a profit that is a tool for development and a measure of competitiveness.

It goes without saying that harmony is not a stock that, once acquired, lives forever. Harmony is a flow, and the leader's primary task will be to ensure that the organization has the capacity to re-establish it whenever the inevitable disharmonies arise in relationships.

One might be tempted to place such a model within the realms of utopia or dream. Minimally, one might think of placing it within the horizons of concrete utopia that we catch a glimpse of in the force of active hope proposed by Ernst Bloch.

Nevertheless, some companies are already operating according to these principles with significant results both nationally and internationally, as in the case of the Pedrollo company in San Bonifacio in the province of Verona, Brunello Cucinelli in Corciano in the province of Perugia, Enrico Loccioni in Angeli di Rosora in the province of Ancona, B&B in Calenzano in the province of Florence or BIONIKE in the Province of Milan.

These companies embody an approach of management embracing the principles of *Humanistic Capitalism and Human Sustainability* and blending the economic and technological dimensions with the cultural, spiritual and moral dimensions instead of opposing them (Martin J., Baccarani C., Brunetti F., 2025). *Humanistic Capitalism* is the “balance between profit and giving back”, “to make profits ethically, with dignity, without causing suffering to people”. *Human*

Sustainability means “promoting the moral and economic dignity of the human being” (Brunello Cucinelli: Speech at the G 20 meeting, 2021).

This is what the notion of ‘wellbeing enterprise or harmonious enterprise’, which has already been embraced by some companies, is addressing.

2.3.2 New strategies: “less is better, less is more or better is better”

The strategy of organizations, of all types and whatever the sector of activity, has to be re-thought almost from a *tabula rasa*. In a + 4°C world where there will be much more strain on resources, greater risks for populations, the strategy of enterprises can no longer be to grow (at all costs) but to find an equilibrium between the scarcer and more costly resources available and the satisfaction of people’s reasonable, that is sustainable, needs both inside and outside enterprises. The stress must then be put on providing products and services which can ensure wellbeing for people without jeopardizing the environment and future generations. In fact, this is what was advocated by the Brundtland Report nearly 40 years ago, but has largely remained unheeded.

Fundamentally, the strategy of all companies until now has been to set objectives that, when reached, which is always hypothetical, aim at making the company grow indefinitely. If one looks at it carefully, he will realize that under many different names, sometimes imaginative, in the end all strategies companies implement result in the objective of increasing revenues. As simplistic as it may seem, market penetration, product/market development, diversification of all kinds, internationalization (see the famous Ansoff matrix), all point to the same objective, i.e. increase, growth, expansion. Such a strategy, in-keeping with the concept of *homo economicus*, based on the assumption that resources are illimited and that markets are indefinitely extendable, is no longer viable, if it ever was, in a + 4°C world.

Therefore, companies’ strategies will have to give up the idea of growth for growth, which always ends up in some kind of ὕβρις (hubris) leading to catastrophes. While growth may seem absolutely natural and can result in a firm’s greater safety and chances to survive in a hyper-competitive market, it is not inevitable. Firms can thrive in niches too and growth has not to be regarded as a dogma. So, an optimum size for companies has to be found, which can be smaller or bigger depending on the economic activity. It has been known for long that if economies of scale exist, though nevertheless based on an increased use of resources in absolute terms, there are also diminishing returns. Instances of companies following a “gentle” growth strategy are already available.

Moreover, production strategies are based on the belief that ‘more is better’, meaning that the satisfaction of consumers is positively correlated to the quantity of goods consumed, in other words that consumers’ needs know no limit. As was shown above (see 2.2), the reality of consumer behaviour contradicts this belief.

And it is not only a matter of quantity: the continuous quest for qualitative improvements, often due to meaningless features; the infinite choice of (apparently) different products; the supposedly new products constantly launched on the market produce regret, fatigue, dissatisfaction in consumers, proving paradoxically to be dysfunctional with respect to the very aims these strategies intend to pursue.

In a + 4°C world, companies will have to reverse their strategy. They will have to follow a strategy where “less is better” because “less is more” (Pope Francis, *Laudato si’*) or, at least, “better is better” (Mintzberg, 2017). This means to offer consumers products with the highest energy efficiency possible, the longest durability possible, the least negative consequences for people and the environment, but ensuring them a level of wellbeing making their lives enjoyable.

2.5 Revisiting performance / New performance measurement

These drastic changes, which will in the end take place by choice – which would be preferable – or by force – which will be more violent –, imply that a new way of measuring ‘performance’ is required and must be accepted by people as users and customers, which is a relatively easier task, by managers, some of whom are already showing the way, and politicians, which is an almost insurmountable obstacle.

This means that the instruments of measurement of performance that have been used now for centuries must be simply dumped: GNP/GDP, of which a majority of economists say that it is meaningless but is still a beacon for about everybody, must be done away with, productivity (of labour) is meaningless in the era of digitalization (apparently paradoxically, productivity of capital has got much more sense), even a measure like the Human Development Index contains many things which have nothing to do with ‘human’. So, new ways of measuring are needed, some of them already existing, trying to focus on the concepts of durability, sustainability and wellbeing. Consequently, the meaning of ‘performance’ has got to be redefined in the light of environmental and human aspects.

As a premise, in general terms, the importance of measurement must be underlined, which is often simply overlooked. The way some performance is measured, as a matter of fact, is not neutral (Muller, 2018).

First, as human beings, we have a sort of fascination with numbers, quantities, metrics. Numbers come from counting, words from reasoning; counting is a less onerous cognitive task and people usually appreciate tasks that require less effort. A number is simple, easy to understand, it does not have different meanings. We are comfortable with numbers because they are able to enclose many aspects in a single set of data. Perhaps this is also one of the reasons for the success that rankings are having. But rankings, while sometimes useful or even necessary, oversimplify reality, not to mention the problems involved in the fact that they often end up turning into a value judgment.

Moreover, numbers, quantities, metrics are straightforward, clear, apparently objective. They are trust-inspiring because they seem indisputable. Words, language, and narratives require complicated conventions to be used and are, at best, dialectical and subjective. At worst, they can be obscure, ambiguous, to the point of being bent to persuasion, or even deception. It is no surprise that storytelling is a highly prized skill, as a good "story" is a powerful tool for convincing people or getting them on your side.

Second, numbers, quantities, metrics inherently push toward a logic of “more”. Intuitively, when one gets a number as the result of some performance, he is usually eager to do better. And doing better means, depending on the circumstances, getting a higher or lower number. When people use a pedometer, if they walk 1,000 steps today, it is quite inevitable that tomorrow they will want to walk at least 1,100. If it takes people 3 hours to walk to the top of a mountain, it is quite natural that next time they will want to do it in 2.55 minutes.

Even if this seems all too natural – and probably has a (good) evolutionary reason behind it – it can sometimes have unintended consequences. This logic of “more” is probably deeply rooted in our human nature, and it is fundamentally a stimulus to improvement, but we should be cautious about it and discern when it is convenient and right to adopt it and when not.

Third, numbers, quantities, metrics – the form in which indicators are expressed – tend to replace the substance of the phenomenon they are intended to measure. Since they are set as the measure of the goal to be achieved, they subtly change their nature becoming the very goal to be achieved and this way influences and distorts action. They act as a kind of shortcut, making invisible every aspect involved while isolating the final result (number) as the only thing that counts. So, they inadvertently force people to improve the final numeric value rather than focusing on the factors, reasons and causes that lead to the result.

If the quality of teaching is measured through the rate of students passing the examination, it is easy for instructors or education institutions to get a better result by lowering the difficulty of the test. If hospitals are ranked by the mortality rate, they are pushed to avoid high-risk surgeries. To the extent this behavior becomes common, serious illnesses cannot find facilities to be treated.

At a macroeconomic level, the use of the GNP/GDP tool must definitely be discarded. This measure is not new. It was first invented by Sir William in the second half of the 17th century and refined at the end of the century by Charles Davenant. In those days, the notion of GDP was used for very specific purposes. In the 18th and 19th century, the use of the GDP measure was not particularly popular. It was revived by Simon Kuznets in 1934 and widely adopted from 1944 (Bretton Woods Conference). Today it is the measure used for every country to evaluate the size of an economy and its evolution.

GDP is the addition of all productions' total value for final use (OECD). Things are fine as long as it is only considered as an accounting tool. The hitch appears when this perfectly acceptable accounting tool is used to measure the 'standard of living' of a population (through the GDP per head). First because GDP does not take into account what makes the 'wellbeing' of people (Kennedy R., 1968) and second because it is purely quantitative, so that a higher rate of growth just says that more is produced and that does not mean that this more is qualitatively better. GDP follows the belief that 'more is better' (see above). Kuznets himself warned about this distorted use of GDP (Kuznets S., 1962). In a +4°C world, it is obvious that the belief in 'more is better' must be ruled out. Even the Index of Human Development (IHD), which is a better measure of 'wellbeing', is not really satisfactory as it includes elements that have little to do with 'wellbeing'.

There will have to be an agreement on some sort of "Green Gross Domestic Product" taking into account the environmental and social costs. Basically, the Green GDP would be the present GDP minus the environmental and social costs. The environmental costs include the value of the depletion of non-renewable natural resources, the cost of the harm done to the environment (e.g. pollution, loss of biodiversity) and the cost of restoring resources (in accounting, depreciation does take into account the loss in value of assets but does not consider the rebuilding of the assets). Social costs include the degradation of the standard of living due to the degradation of the environment and extra expenditures (e.g. health) caused by the degradation of the environment. Traditional accounting techniques totally ignore these aspects. The debate is not very new (Nordhaus W., Tobin J., 1972). More recently, the United Nations has proposed a System of Integrated Environmental and Economic Accounting (2012). However, such a system, albeit being a great improvement, is not fully focussed on the wellbeing of populations. The task is to design a 'Domestic Wellbeing Product' which does not primarily rely on 'production' but on 'benefits' for people. The main problem, however, remains to wean politicians off the classic GDP which overall causes as much harm, maybe more, as good.

At the microeconomic level, that of enterprises, strategies and operations of businesses similarly need to change focus. Whatever the different guises it may take on, the strategy of all enterprises is to grow, to increase market share, to increase revenues and hence profits.

As mentioned, all of this is also possible, especially in today's environmental situation, by acting according to the model of the harmonious enterprise.

The adoption of this model will of course not eliminate the use of corporate metrics as such—investments, budgets, productivity, market share, and profitability. However, these indicators will be used to monitor progress, as guidance tools, not as parameters for measuring results.

Results will be achieved when the company produces high-quality, useful, functional, beautiful, and sustainable goods or services—that is, when the company views the production process as a service to people.

Monitoring performance will certainly be useful for identifying the need to take action if results are not in line with plans and understanding what disharmonies have affected them.

From this perspective, it is clear that a harmonious enterprise requires a cultural leap for a management team accustomed to acting on quantitative indicators, neglecting to investigate the nature of the disharmonies that have generated a certain result.

Harmony is aimed at well-being and, at the same time, is a function of well-being. But while the well-being of various individuals can be measured in some way, it is very hard to measure the harmony that exists within an organization. In fact, harmony, like quality and beauty, you see it or feel it when you encounter it. There are no definitive indicators that can truly measure it because every case and every situation is different, as harmony is, or is not, an attribute of the organizational atmosphere.

However, it can be said that the driving forces of harmony are empathy, which encourages each person to put themselves in the other's shoes, and the exotype, which teaches us to recognize the other as different from ourselves. The cultural leap required lies in accepting that not everything is measurable and that the most important factor can only be gleaned from people's perceptions.

The only possible measurement in this regard is the intensity with which the main values (listening, beauty, dialogue, trust, play, rhythm, tenacity, and humility) that generate harmony are lived and perceived. For such a measurement purely quantitative metrics are useless. But some qualitative ones can be designed.

Freeing oneself from the straitjacket of measurements is the necessary act of courage to valorize the true meaning of measurement by accepting that the most important things are not visible to the eyes but only to the heart (Antoine de Saint Exupéry).

Conclusion

In spite of the multiplicity of converging studies about the continuing degradation of the environment and warnings about the catastrophic upheavals (etymological meaning of *καταστροφή*) that climate change has started causing and will be causing in the coming decades, very few actors in the political arena have yet integrated the full measure of the challenges the world is facing. The impacts of environmental changes far exceed what people believe or are made to believe. Some political leaders still deny the reality of the present and coming situation. As a result, almost none of the actions required to survive in a world which is heading towards an increase of 4°C at the end of the 21st century is being taken. Some decisions even encourage a worsening of the situation. Consequently, almost none of the objectives adopted at the COP 21 in 2015, which were supposed to be compelling, will be reached. More than ever, a drastic revolution in management, in a broad sense, tenets and practices is unavoidable, whatever a good number of politicians (who do not deserve the name, Aristotle would say) may say. It is just a matter of survival for the human species.

It is on businesses, as go-between worlds that connect the lives of individuals with macroeconomic and social phenomena (Rebora, 2024), that we must rely on to address the issues we have tried to illustrate in this work.

“The world began without man, and it will end without him”

Claude Lévi-Strauss, *Tristes Tropiques*, 1955

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