

Smart Growth

The Green Revolution

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Introduction: End times or begin of a new era?

Forty years after the thunderbolt that Dennis L. Meadows and a group of young researchers set off with their study on "The Limits of Growth", the debate about growth is experiencing a renaissance. Unfortunately, this debate is suffering from acute schizophrenia: in feature newspaper articles and at conferences the cry of "Farewell to the growth mania" rings out. At the same time all of Europe is pleading for a way to break the downward economic spiral. Saving or economizing alone will only lead deeper into the crisis. The magic spell that will shatter the vicious cycle of debt and unemployment is called "growth". Until now the reinvigoration of economic growth has been a pipe dream. Instead of producing a Green New Deal capable of catapulting the European Union into the lead in ecological innovation, the governments vacillate and manoeuvre from one rescue program to the next. The only way that Europe will get back on its feet is if it embraces the crisis as a sort of great leap forward. It must be seen as an opportunity for greater political integration and, simultaneously, for the renewal of its economy. Europe has the potential to become the trailblazer of the green revolution. This question will be decisive both for the prosperity of coming generations and for Europe's future role in the world.

In the face of a growing world population, with all of its needs, desires and ambitions, the dream of a post-growth society seems like a delusion or a flight from reality. The idea of retiring from global competition into a state of self-contained tranquility may seem attractive to many traditional Europeans. In the estimation of the rest of the world this would amount to a retreat into insignificance. Europeans themselves would soon discover that the "post-growth society" was no carefree idyll but rather a showplace of social drama and competition for the allocation of resources. Greece is experiencing such a nightmare at this very moment. However, the notion that we could

once again indulge in the resource-devouring, energy-intensive sort of growth of the twentieth century is equally unrealistic. This would be tantamount to shutting our eyes to the ecological crises that are arising before us. Climate change, the progressive loss of fertile land, and the emerging problem of water shortage in the most populous regions of the earth – these are unmistakable signs that the economic systems that we have heretofore practiced are in the process of destroying their own bases for existence. We are in the process of overwhelming the limits of vital ecological systems. If such trends continue, we run the risk of severe ecological dislocations and upheavals.

If “Keep it up!” is a crime against the hopes and life chances of future generations, and appeals to simply do without are ineffective, what is the alternative? That is the key question of this book. We are talking about entering a new age of ecology that adheres to the idea of progress, yet narrates it in a new key: as the history of the co-evolution of humankind and nature, with a potential for development that we have barely begun to tap. The present crisis does not represent the apocalypse of technological-scientific civilization, but rather the transition from an age where industry was powered by fossil fuels to one whose ecological method of production is already appearing in its outlines upon the horizon. Its power plant is the sun. A Europe-wide network of renewable energies is delivering climate-friendly electricity and thermal energy. Buildings are becoming miniature power stations that produce more energy than they consume. We circulate through the cities using a smooth combination of public transportation, bicycles, and electric autos that can be rented out and returned again. Electrical batteries function, at one and the same time, as energy storage devices that accommodate excess electricity, and then deploy it again during periods of high demand. The miniaturization of technology reduces the consumption of materials. Computers, machines and motors are becoming smaller, lighter and more productive. Integrated value chains enable the optimal utilization of natural resources. Waste products flow back into the biological or technological cycles. Device design is determined by energy efficiency and recycle ability. Ultrafiltration stations transform waste water into drinking water. Near cities agro industrial centers arise, combining

agriculture, gardening, animal husbandry and processing, and energy production in closed circuits. A segment of food production is returning to the cities. Vegetables, fruits and mushrooms are being cultivated in all seasons of the year in old factories, vertical greenhouses and roof gardens. Industrially produced carbon dioxide is being used in the operation of greenhouses and the cultivation of algae. The recultivation of land, the closed substance cycle economy and refinements in plant breeding enable a long-term increase in agricultural yields. Biotechnology – the technological application of biological processes and resources – is becoming the world’s leading branch of science. Artificial photosynthesis makes possible the transformation of sunlight, water and carbon dioxide into synthetic fuels. Bioreactors produce chemicals from organic waste products and cellulose. Economy enters into a metabolic relationship with nature. The earth is no static element but rather a dynamic system full of yet undiscovered possibilities. Intelligent growth means growth with nature.

In Germany, this sort of confidence is alien, if not outright suspect. Anyone who privileges the spirit of invention and innovation is quickly accused of a naïve faith in technology. Instead, we prefer to cultivate a fatalistic view of things: the tremendous growth of the last 150 years in the Western world was an exception. It cannot be prolonged or geographically extended. The prosperity of the industrial nations has come about as a result of the exploitation of nature. You cannot have continuous growth and sustainability at the same time. Available resources are running out. The party is over. Only poor people in developing nations live in a sustainable way. If they attempt to emulate our prosperity, the final collapse is near. Our standard of living cannot be globalized. And so we have to cut back radically. If we do not step back voluntarily, a series of crises and catastrophes will prune civilization back to a size that is compatible with nature.

I do not share this way of looking at the world. Yet, no one can be certain that these gloomy warnings won’t turn out to be true. Despite all the climate conferences and declarations of intent, world-wide greenhouse emissions reached a new peak in 2012. If

this trend continues, climate change will assume truly threatening dimensions. We are in the midst of a race between innovation and disaster. In order to win this contest, we require nothing less than a green revolution. There is no master plan for this, no "A to Z" list that tells us what to do. As in every revolution, we are engaged in a search process whose outcome is still open. We need to be clear, however, about the direction in which we are going: Are we moving forward to new horizons or managing a well-organized retreat? Are we standing on the edge of a new age of innovation or of a period of managing shortages and scarcity where our chief task is overseeing the just distribution of "less"? These are vastly different messages and emotional sonorities. Depending upon which "tune" we decide to sing, we will create quite different dynamics and alliances.

Cultural pessimism has been experiencing a veritable boom since the finance bubble burst in 2008. This is hardly surprising. We are familiar with this way of thinking from capitalism's earlier crises.¹ Confidence gives way to bourgeois self-doubt. Fear about the future spreads through the middle class. Most Germans no longer believe that their children will have a better life than they have themselves. The shift of the center of world economic power to the Pacific strengthens the feeling that Europe has passed its zenith. Left-wing critique of capitalism connects to conservative discomfort with the values of consumer society. Those who interpret the present fissures and cracks as symptoms of the final crisis of growth-driven society overlook the fact, however, that crises serve as catalysts for the modernization of capitalism. The welfare state came into being as a reaction to mass poverty and the rise of the labor movement. Roosevelt's New Deal was the answer to the Great Depression of the early 1930's. Social Democracy succeeded the devastation brought about by National Socialism and war.

¹ See Werner Plumpe: „Konjunkturen der Kapitalismuskritik“, in *Merkur. Deutsche Zeitschrift für europäisches Denken*. June, 2012.

Today we stand on the threshold of a new great transformation. It is taking place in many dimensions simultaneously:

- Globalization is breaking new ground. It literally encompasses the smallest corner of the globe. New technologies, ideas, movements and life styles are becoming global phenomena. The conflict between tradition and modernity is being experienced in all cultures and on all continents.²
- Economic dynamism is shifting from the transatlantic axis to that of the Pacific. The traditional industrial nations are losing their monopoly on high-quality products and technologies. The countries making up ground on them are able to leap directly into the Age of High Tech.
- As part of the rapid rise of the former Third World, billions of people have been able to rise from poverty into the middle class. What was once considered the “Western life style” has become the way of life of the global middle class. This has increased pressure on natural resources.
- The global mobility of capital and products corresponds to an increasing mobility of human beings, despite all attempts by sovereign states to maintain control of their borders. A new transnational elite is being born.
- The technology of modern communications is compressing time and space. It enables worldwide cooperation and action on a scale and at a speed never before imagined.
- The digital world, flowing in the global net as an endless stream of information, images, thoughts and communications processes, is acquiring its own reality, a reality that impacts the analogue world (the world of things). The virtual world and the real world begin to merge

² It is not the so-called “Clash of Civilizations”, seen by Samuel Huntington as the new axis of conflict in world politics that is operative in the global situation. Rather, it is the conflict between modernity and restoration that is being fought out within the various societies. Its fields of battle are the relationship between the state and religion, the gender question, pluralism versus homogeneity, and liberal democracy versus authoritarian order.

- Knowledge about the world is growing exponentially. Never before have so many researchers around the world worked toward new finding and new solutions. The speed of innovation is increasing. Digitized knowledge about the world is potentially available to all. Education is becoming our most important resource.
- The neurosciences, information science, genetic research, biotechnology and nanotechnology are converging into “Life Sciences”. The boundaries between biology and technology are becoming blurred. Human beings are creating nature.
- The conflict between the rapid growth of the world economy and the needs of excessively stressed central ecological systems will force the development of a synthesis between ecology and economy: from predatory exploitation of nature to cooperation with nature, from fossil energy to renewable energy, from linear production chains to material cycles, from the maximization of output to the optimization of processes.
- The transnational ecological systems upon which human civilization depends, will be placed under the administration of the international community as global public goods, based on the model of the Antarctic Treaty. The Montreal Protocol for the protection of the ozone layer is an example of how a threatening development can be averted through collective self-regulation.

Around the world millions of people are already participating in this new stage of the Industrial Revolution – Researchers and engineers, architects and city planners, entrepreneurs and investors, environmental activists and critical consumers, journalists and artists, as well as legions of fellow citizens engaged in large and small ways for a better world. Protests and cultural counter-movements, as much as science and technology, are the indispensable impetus for capitalism to shed its old skin. Finally, political life on all levels – from the town council to the United Nations – must clear away obstacles in order to open the path to ecological modernity.

From the natural to the human world

In a world containing nearly nine billion people the idea of “Back to nature” is not a realistic option. There are too many of us and we have too much impact upon our environment. We are far past the stage of a “natural” way of life. After our long march through history, we have arrived in the Anthropocene Age – the era in which the primary influences upon the earth’s systems are those of humankind. In 1873, the Italian geologist Antonio Stoppani already spoke of a new anthropozoic epoch: Mankind, as a new earthly power, could compete with the great forces of nature, in terms of power and universality. Paul Crutzen, who received the Nobel Prize in Chemistry for his investigations of the ozone hole, looked again at Stoppani’s ideas around the turn of the millennium. In an article from 2002 published under the title “Geology of Mankind” in the scientific journal *Nature*, he described in broad strokes the growing impact of humans upon the biophysical world.³ He suggested that the advent of this new terrestrial age could be dated to the invention of the steam engine by James Watt, in 1784. Ever since then humankind has been altering the earth’s climate through the increased concentration of carbon dioxide in the atmosphere. This signaled the end of a ten-thousand-year period of stable climatic conditions, in which temperatures varied only within a range of approximately 1.0 degree Celsius. Crutzen believes that scientists and engineers have the responsibility for guiding humanity through this new critical age, and in the direction of a sustainable management of the environment.

Almost every corner of the earth shows the evidence of human impact. Vast expanses of its surface have been shaped by human beings. Barely a quarter of the earth’s surface – particularly the ice-covered polar regions and the large desert regions - can still be considered wilderness. We impact oceans, the animal and plant worlds, soil

³ Can be read on the website of the University of Mainz: <http://www.studgen.uni-mainz.de/sose04/schwerp3/expose/geology.pdf>

fertility and water circulation. Even the climate and the earth's ozone layer are no longer purely natural phenomena. The history of the species human being can be viewed as the history of the expansion of the human world into the natural world. Ever since their expulsion from paradise, humans have been altering the topography of the planet. The creature becomes the creator, a powerful agent of evolution. This already commences with the earliest forms of farming and the domestication of wild animals. The more effective the tools that humans used in dealing with nature the broader and deeper the marks they left behind. They cleared forests and regulated the flow of rivers, extracted new farmland and land for settlement from the sea, built railroads, canals and roads. Settlements became cities, wilderness was turned into cultivated land. New animal species and plant types came into being, many others vanished forever. The field of modern genetics is merely one further step on the long journey of the alteration of our environment and the self-change of the human being. The boundaries between nature and culture dissolve, civilization and biosphere merge into a hypercomplex system. In his book *Menschenzeit* [*The Age of Man*] the science journalist Christian Schwägerl has encapsulated the scientific literature of this new era. He quotes the American geographers Foley, Ramankutty and Ellis, who call for a change in our way of looking at ecological issues: "It is really outdated to regard the earth as a natural ecosystem that is being destroyed by human beings." In reality, the earth has become "a human system with embedded natural ecosystems." In the Anthropocene Age it is no longer a question of preserving nature, but of cultivating the biosphere in a sustainable way.⁴ Every step in the transformation of nature has been accompanied by fear. Warnings about hubris, sadness about losses that come with progress, the feeling of falling into a maelstrom in which we become lost, the admonition that riches are illusory – these are not an invention of the environmental movement, but rather the ancient tune that has accompanied every new transgression of boundaries from the Tower of Babel to the invention of the railroad. "This is headed for annihilation" is Mephisto's final comment upon Faust's restless entrepreneurship. Goethe stages the

⁴ Christian Schwägerl: *Menschenzeit. Zerstören oder gestalten? Die entscheidende Epoche unseres Planeten.* (Munich: Riemann, 2010), 20.

monetary economy, industry and the domestication of nature as a progression into ruin. The elements that have been tamed by force are more powerful than the ingenuity of engineers. Almost simultaneously with *Faust*, Mary Shelley's nightmare novel *Frankenstein. The Modern Prometheus* appeared. She placed the tragic hero in a line with the ancient fire-bringer and rebel against the gods, who paid heavily for his sacrilege. Frankenstein, too, violated the divine order by bringing a humanoid creature to life. When he realized with horror the consequences of his stroke of genius, it was already too late. His tragic creation was beyond his control. It became a monster that turned against humankind. Both Goethe and Shelley anticipated the ambiguity of the "scientific-technological revolution" at a time when it was still in its infancy.⁵ In their work all of the basic patterns in critique of progress – today so familiar as to be clichés – are already present: From the restless acceleration of life to the illusion of endless growth. One central topos is the warning about a deluded belief in human capacities, the idea that everything is possible and permitted for human beings, just as for the gods. The motif of the sorcerer's apprentice, who can no longer exorcise the spirits that he has conjured up, is still evocative today.

Flexible boundaries

Boundlessness versus boundedness – the debate between these alternatives has been going on since antiquity. In actuality, these two are a dialectical unity. Neither individual nor societal life is possible without boundaries. On the other hand, the history of civilization is the story of a continuous overstepping of cultural, technological and natural borders. It is not hard to see that this ancient debate also resonates in the contemporary controversy surrounding genetics and synthetic biology. *The Limits of Growth* is a classic of the modern environmental movement that shaped the thinking of an entire generation. The title became a familiar expression. The computer model

⁵ *Frankenstein* appeared in 1818. *Faust II* was published in 1832, a few months after Goethe's death. He had completed the first part of *Faust* in 1805. It was only twenty years later that he began working on this material again.

developed by Dennis Meadows and his study group appeared to demonstrate convincingly that continued economic growth would lead to an ecological collapse within the foreseeable future. If we do not slow down voluntarily, the massive increase in environmental pollution and the exhaustion of natural resources will force a downturn in production and consumption. The earth system is being thrown out of balance, disastrous scarcity crises are decimating whole populations. The message is hard and clear: The expansive age of humanity is coming to an end. Self-limitation or destruction – *tertium non datur* [there is no third option]. If we examine this soberly, we see that this position is not new. The British theologian and economist Thomas Malthus, a contemporary of Mary Shelley, already predicted severe famines because population growth was exceeding the food producing capacity of the earth. At the time that his essay “On the Principles of Population” appeared, world population was approximately one billion persons. Today there are seven billion of us. Our life expectancy is more than twice as great, and the living standard of the modern middle class would make the aristocracy of the early nineteenth century green with envy. It is true that a billion people suffer from hunger, but they are not undernourished because agricultural production is insufficient. The problem of hunger is a problem of poverty and, at the same time, a problem of wastefulness: too much grain is used for the production of animal feed and too much is lost on the way from the field to the consumer. The apparently rigid limits of growth have turned out to be flexible magnitudes. The drivers of such growth are inventiveness, science and technology – the Promethean forces. And lastly, it was democracy, with its support of voting rights for the poor, labor unions and freedom of the press, which fought against impoverishment. Today it is the worldwide ecological movement, in collaboration with scientists and pioneering companies, which serves as a catalyst for the ecological turnaround. This is no guarantee of success. Progress and destruction, improvement and endangerment of human living conditions, new departures and losses are indissolubly intertwined. That is not to say that they balance each other. The history of the modern era is no zero sum game. Despite all its setbacks and catastrophes, it is a history of progress. Two sets of forces impel it forward: the permanent scientific-technological revolution and the unfolding of

democratic freedom. It is only in conjunction with democratic and social rights that technological history becomes the history of progress.

The participation of the broad masses in economic progress is something that has always been achieved through struggle. This is again the case today. After a phase of economic equalization in post-war capitalism, the gap between rich and poor has been growing again since the 1990's. While wealth is growing at the top end of the social ladder, the numbers of working poor are increasing. The real income of the broad majority remains stagnant or is even decreasing. Economic growth is no longer experienced as "progress for all". This raises doubts as to whether the model, in its entirety, makes sense: Why should people strive in school, training and career, if it doesn't get them anywhere? What is the point of an increase in the gross national product if it does not lead to additional prosperity for all? Equal opportunity and social equity aren't just a question of fairness: they are central for economic dynamics and the political acceptability of the market economy. Ecological innovation and social participation must go hand in hand. This isn't just a matter of compensatory tax- and social policy. Considering the widening gap in the distribution of wealth, the old idea of the participation of workers in productive assets has become relevant again. At the same time, we have to examine the conflicts of interests involved in a green economy. Not everything sold under the label of "green" is sustainable. The replacement of mineral oil by biofuels sounds good initially. But when the conversion of corn, soya or palm oil into biogas and ethanol undermines food production, increases land erosion and the destruction of the rain forests, the benefit turns into a scourge.

Despite all the drawbacks and losses: there is no question that for the great majority of humanity economic growth has been a blessing. Life expectancy and living standards have risen rapidly for billions of people throughout the world. Their opportunities for self-determination, their personal options and degrees of freedom have all broadened. These things are all inseparably linked with the economic boom that began with the Industrial Revolution. In spite of all gloomy predictions, this is still the case after

globalization received a new impulse with the collapse of the “communist world system”. Along with the expansion of the industrial modern age the idea of human rights has also spread around the globe. Levels of education are rising on a broad basis. More and more young people are studying abroad, and the internet is making possible global exchange of information and ideas. However, the continuation of this success is not guaranteed. It would be negligent to ignore the warning signals that have been accumulating during the last few years, from dislocations in the financial system to symptoms of illness in the ecosystem. The hunt for scarce resources has led to a new rearmament race. A return to armed geopolitics looks to be on the horizon, particularly in the Pacific. The interconnectedness of global markets and the inflation of the finance sector increase exponentially the vulnerability of the system to crises. We are not playing down these dangers. It is easy (and popular) to paint the future as dark and threatening. But it is much more rewarding to search for the elements of a new leap forward, for a new model of ecological and social progress that is emerging in the midst of the crisis. That is the goal of this book.

Uneasiness with growth

Before the Big Bang of the Industrial Revolution, humanity’s intrusions upon its environment were on the local or regional level. The effects might be severe, but the scope was limited. This changed with the onset of the age of fossil fuel. Coal and oil provided a tremendous impulse for industry, transportation, agriculture, urban development and consumption. Unfortunately, there was an unintended side effect: the continuously increasing concentration of carbon dioxide in the atmosphere amplified the greenhouse effect. Temperatures increase, polar ice melts, and geothermic cycles change aberrantly. The ecological crisis and the financial crisis impose themselves worldwide. The vigorous economic growth of the developing countries, with China in the vanguard, is intensifying the ecological stress. When billions of people drive their cars, use computers, live in comfortable houses, travel by air and eat steaks, it

suddenly becomes clear that the previous resource-intensive mode of production has no future. We have already reached the point where the costs of a form of growth based on exploitation outweigh the benefits. Unfortunately, the loss of arable land, the over-exploitation of drinking water reserves, and preprogrammed climate change appear nowhere in the balance sheets of national economies. This does not mean that these bills won't have to be paid someday. This time is approaching. The later we change course, the greater the future loss of prosperity will be.

Worldwide carbon dioxide emissions will have to be reduced by half by the middle of the twenty-first century if we hope to stabilize the climate. No one seriously disputes this. The consequences resulting from this realization are up for debate, however: Must we, as a privileged minority, drastically limit our material demands and hope that the societies of Asia, Latin America and Africa are able to resist the temptations of the modern age? Should we consider Diogenes with his tub as our role model? For him frugality was the precondition for liberty, and striving for luxury, career, power and fame were simply various forms of slavery. Does our salvation lie in a heroic rejection of the temptations of the consumer society. Shall we act as Odysseus once did, when he commanded his comrades to block their ears with wax while he chained himself to the mast of his ship, so that they would not succumb to the song of the sirens?

The critique of a culture whose purpose is solely the acceleration and intensification of life has a long tradition. Yet, it appears that this critique is currently experiencing a boom. Basic doubts about the growth society are increasing before the background of the ongoing financial crisis, the excesses of the finance industry, the insecurity of the middle class and harsher competition on the world markets. Measure and moderation instead of greed and stress, safety instead of risk, values instead of cash – this the new spirit of the times. This is the intellectual breeding ground for a new critique of growth that, in many ways, seems like a revival of the 1970's. Contained within this critique is an entire complex of motives. Many people believe that growth is possible only at the cost of the natural environment. Many others expect only minimal growth rates from

the European national economies in any case, so that we might as well get used to the idea of a future without growth. From this perspective, the politics of growth is an expensive fiction and the new realism is prosperity without growth.⁶

Capitalism does not recognize inherent limits upon growth. It is conceived and designed for continuous increase. This, of course, clashes with the quintessentially “green” idea that “unlimited growth is not possible in a world with limits.” Some people are fascinated by the endless cycle of new production and new needs while others find it ominous, and feel uneasiness with a culture that strives for success at any price. The short-lived high of neoliberalism, the unleashing of the markets, and the time of uninhibited enrichment is over. The desire is growing for a more sensible balance between material prosperity and intangible goods and values. Love, friendship, decency, enjoyment of life: The best things in life are free! For many young people family and friends, self-determination at work, and idealistic engagement with the world have become more important than consumption and career. They agree with Wolf Biermann’s verse: “We would gladly have prosperity / Rather than prosperity having us.” People chiefly want an assured income, good medical coverage and a solid future. The riskier the world appears the more defensive ideas and values meant to preserve security will crowd out soaring hopes and ambitions. This does not appear to be an economic phenomenon but rather the sign of a deeper change. Isn’t it wonderful that “Money is cool” and the equally vulgar “Cheap is cool” have become passé, that values have become more popular than quick success? Of course! My daughter’s generation no longer makes a distinction between political morality and private life. They try to live out global justice in their everyday lives. Many are vegetarians, support Fair Trade, and are not enslaved to fashions and brands. They get involved in the fight for human rights and equality. Work isn’t just a way to make a living but ought to be meaningful as well.

⁶ Hence the title of a highly respected manifesto by Tim Jackson, Professor of Sustainable Development at the University of Surrey: *Prosperity without Growth*. London/Sterling, VA: Earthscan, 2009. The German edition was published by the Heinrich-Böll-Stiftung. [The last sentence is in the original text but is probably not relevant for an English audience. It should probably be cut.]

They are ready to work hard but do not want to climb the ladder at any cost. Such attitudes give us hope for the future.

Still, an intangible yet real fatigue hangs over the debate about “getting out of the growth trap”. The dynamics of growth have migrated to Asia, China is preparing to overtake America, Africa is waking up from a stagnation that has lasted for decades, and Europe is still living off its former greatness. Let it be! Let us go down with dignity. Peter Gauweiler, the maverick of the Christian Social Union party, recommends that Europe think back to its regional traditions. He sings the praises of the small-state mentality, and thinks that it is better for Europe to stay out of international commerce. The European Union as a joining of forces to keep up with the Big Boys? No, thanks! We know only too well where that leads. Meinhard Miegel, the unconventional thinker of the conservative milieu, talks about “the exhaustion of the expansionistic way of thinking, feeling and acting that was the force behind the Euro.”⁷ He criticizes the erosion of borders, complains about the lack of security, and states with a certain amount of satisfaction that it is not only Europe but much of the rest of the world that is showing “signs of fatigue”. Every attempt to inject growth hormones into the economy through a shot of credit been a case of “love’s labors lost”. Europe has simply quit growing. Its economic vitality is exhausted. We are looking now to maintain the functionality of society in conditions of economic contraction. In a word: we have to organize our retreat without letting social structures collapse.

I agree with the diagnosis that it is pointless for Europe to continue pursuing old levels of growth. “Old” here stands for debt-financed and resource-intensive. We can escape neither the economic crisis nor the ecological crisis with “more of the same”. Should we draw the conclusion from this that we have to definitively say goodbye to growth? Not at all! “Zero growth solves not a single problem, it merely creates new ones,” writes Martin Jänicke, the longtime director of the Environmental Policy Research Center at the

⁷ Meinhard Miegel, in an interview with the *Frankfurter Allgemeine Zeitung (FAZ)* of 08/11/2012, p. 33.

Free University of Berlin.⁸ From the ecological perspective, zero growth means merely that the consumption of natural resources is remaining at a steady level - this is not an improvement. Appeals to abandon the gilded cage of consumerism are ineffective because they do not examine the methods of production themselves. Karl Marx was right when he said that the critique of culture is no substitute for a critique of production conditions. The demand to forego consumption is radical only on the surface. It misses the core of any ecological transformation: a fundamental change in the dominant production methods, including agriculture, energy, transportation and urban development. This is particularly the case if we do not spend our time gazing at the collective European navel, but look out at the rest of the world.

The debate about the post-growth society takes no account of the global dynamics of growth in the coming decades. Whether the world economy grows or not will not be decided in Europe. China will certainly not remain the long term growth locomotive of the world, with yearly growth rates of eight or nine percent. Nevertheless, world rates of growth will more likely lie above three percent than below. The billions of people standing on the doorstep to industrial modernity will see to that. They have one primary goal in view: to improve their standard of living. This will give a tremendous impulse to the demand for living space, food, consumer goods, transportation and services of all kinds. In essence, economic growth is the result of two factors: first, from increasing input of capital and work and second, from scientific-technological innovation leading to increased productivity. In the coming years there will be no lack of either.

It is in the aging societies of Europe and Japan that dynamic energy is waning. Even these groups would do well to invest in education, science and innovation, in order to ride out the demographic changes without a drastic loss of prosperity. In the long term, this is the best way to compensate for sinking numbers in the labor force. It is not yet

⁸ Martin Jänicke: "Radikal schrumpfen, radikal wachsen", in *Böll. Thema, das Magazin der Heinrich-Böll-Stiftung*, 2/2011, p. 30. Jänicke has spent decades studying the policies of ecological innovation. See his latest book: *Megatrend. Zur ökologischen Modernisierung von Wirtschaft und Staat*. Munich: oekom-Verlag, 2008.

clear if Europe will remain a magnet for qualified immigrants – other regions, where the economy is booming, are increasingly attractive. There are still broad opportunities for sustainable growth on the Old Continent, however. Ecological modernization of capital stock and infrastructure will require a great deal of investment. Old facilities and machines are replaced by new resource-efficient technologies more quickly in a dynamic environment than they are in stagnating or shrinking markets. If sales, income and tax receipts sink then investment in innovation would decrease with them. That would be fatal. We are standing on the threshold of an energy revolution requiring tremendous investment in wind- and solar power facilities, transnational electricity networks, and energy-saving technologies. The situation is comparable in the transportation sector. New, environmentally friendly vehicles and a flexible system comprised of public and private means of transportation will change the face of our cities. There is a large-scale investment backlog in the area of retrofitting buildings for energy efficiency. This represents no more and no less than the radical renovation of the entire technological apparatus and public infrastructure, comparable to the great drives for modernization of the Gründerzeit [German late-Victorian industrial revolution] and of the years after the Second World War. There are also great needs in the area of education, especially in vocational training and continuing education. The need for health care services will continue to increase. In view of demographic change, we will have to invest much more in treatment and nursing care. We will need as productive an economy as possible to realize these goals.

The majority of Europeans do not live a life of luxury, where private consumption is concerned. The circle of people who cannot figure out how to spend all their money is fairly small. Even in affluent Germany, half of all households had less than \$1,700.00 per month at their disposal, after deduction of taxes and social security.⁹ These households are suffering from a lacking of buying power, not from overabundance. The further east one travels, the clearer it becomes that the large majority of Europeans by

⁹ Weekly report of the German Institute for Economic Research, Berlin, 24/2010.
See: http://diw.de/documents/publikationen/73/diw/_01.c.357505.de/10-24-1.pdf.

no means lives in post-material prosperity. There is no question of an oversaturation of wealth. This is even more the case when we look beyond Europe. The great majority of the world's population lives today in precarious circumstances. Billions live on the edge of hunger, without electricity, flowing water or adequate medical care. In addition, world population is expected to increase by two billion by the middle of the century. In the end, it will be the needs, desires, and ambitions of these people that will power future economic growth. The question is not *whether or not* the world economy will continue to grow, but *how* it will grow. In the face of mass poverty in today's world, "zero growth" is neither realistic nor desirable. "Just keep going" just won't work. The third option, the one that this book advocates, is an ecologically sustainable, socially inclusive type of growth.¹⁰

It may be the case that an economy based upon a synthesis of nature and technology will someday reach the ultimate limit of growth. This is an open wager. It may be also be that material needs will become secondary to the desire for additional rewarding time and for self-development for an increasing number of people. The great majority of the earth's inhabitants, however, is moving in the opposite direction. There are more than sufficient energy reserves to power the industrialization of the developing countries. There is still plenty of coal and gasoline. Even the level of known oil reserves is higher than it was forty years ago. Most metals and minerals are still available in large amounts. If the supply of special raw materials lags behind the demand, the prices rise. Higher prices lead to the search for and discovery of new deposits, the more efficient use of scarce resources or their replacement by other materials. The depletion of raw materials is not the critical obstacle for economic growth. The heedless exploitation of available resources constitutes a far greater danger for the planet. If even ten percent of the estimated reserves of coal, oil and gas were exploited and combusted, we would cross the critical threshold of a global rise in temperature of two

¹⁰ UNEP, the United Nations Environment Program, defines a "green economy" as an economic system that leads to improved human well-being and social equality, reduces environmental risks, and avoids ecological scarcities.

degrees Celsius, on account of the greenhouse effect.¹¹ Greenhouse gas emissions are not the only problem associated with industrial society's hunger for resources. Normally, the production and processing of raw materials goes hand in hand with a high level of expenditure of energy, water and chemicals. They produce devastated countrysides and contaminated water supplies. An abundance of raw materials can become a curse, especially in those developing countries where public institutions are weak and the ruling elites are corrupt. We have to learn how to use natural resources more efficiently, introduce critical raw materials into closed loop technologies and, little by little, replace them by materials that are more environmentally friendly. This is particularly the case for green technologies (wind- and solar power facilities, for example) that make use of metals such as copper, silver, platinum and palladium. Parallel to this, we need to establish a system for global resource management that will guarantee a maximum of transparency, as well as high environmental and social standards. New partnerships between industrial, environmental and human rights organizations are playing an increasing role here. They agree upon criteria for the sustainable use of raw materials and award seals of approval that consumers can use as guides¹².

The critical limit of economic growth lies in the ability of the central ecological systems climate, soil and water, to bear the environmental burden. Climate change, in particular, looks to have what it takes to become the mother of all crises. To avoid playing all-or-nothing, we have to keep the concentration of carbon dioxide in the atmosphere under 400 parts per million at all costs. Beyond this critical level incalculable climatic effects are waiting. The conclusion is that the atmosphere can still absorb a maximum of only 840 billion tons of carbon dioxide. This sounds like a

¹¹ See: Ottmar Edenhofer and Michael Jacob: "Die Illusion grünen Wachstums" [The Illusion of Green Growth], *Frankfurter Allgemeine Zeitung* of March 2, 2012. The authors argue that a shift to resource efficiency and renewable energy *alone* will not be enough to arrest climate change. Because the reserves of fossil fuel sources are so great, a global climate treaty agreement is urgently needed, in order to limit access to these reserves. "Green growth cannot replace such a regulatory framework, but it can, perhaps, help to bring it about."

¹² See the study *International Resource Politics*, published by the Heinrich-Böll-Stiftung in collaboration with the Wuppertal Institute for Climate, Environment and Energy. Berlin, 2012.

tremendous amount, but it really isn't. In 2011 the worldwide emissions level rose to a new record of 34 billion tons. If this level of emissions continues we will use up our "carbon dioxide credit" in 25 years. By the end of the century the earth would probably have warmed by 4 to 6 degrees Celsius. We urgently need to act. There is not much time left to turn rising levels of emissions into sinking ones. We will only be able to make this change if we radically increase our energy efficiency and turn from fossil fuels to renewable energies. We have to limit carbon dioxide emissions through global agreements and place a price tag upon emissions, if we want to accelerate the process. In conjunction with this we will have to extract carbons from the atmosphere through intensive reforestation, enrichment of the humus layer or by means of employing carbon dioxide as a raw material in chemical production.

On the basis of climate science findings it is abundantly clear that we have to do something. These findings do not tell us, however, how great a volume of goods and services will be available to us without running the risk of climatic dislocations. This depends decisively upon two dynamic factors: the transition from fossil energy sources to renewable energies, and the efficiency with which we use scarce resources. An economy based upon solar energy and biological material cycles causes no environmental problems. The limits of growth are the outcome of the biosphere's capacity to sustain the ecological burden, and the human spirit of invention. One of these factors is limited, the other potentially infinite. In the long run, only the transition to resource-light, climatically neutral types of production will make possible an increase of economic prosperity. Green growth or collapse – that is the alternative. The key to sustainable growth lies in decoupling value creation from the consumption of nature.

Modernization of the modern

Shutting down the dynamic energy of the modern age is neither desirable nor economically promising. Not desirable because there is still too much poverty in the

world that cannot be overcome through simple redistribution. Also not desirable because an appeal to self-limitation can easily become a tyranny inflicted by virtue. What is worthwhile about a future where everyone receives a lean emission and resource ration that dare not be exceeded? What do we do if the Old Adam (even more the Old Eve – after all, it was she who broke the commandment about eating from the tree of knowledge) refuses to give up his quest for “higher, further, faster”? Must he then be forced to deeper insight? Whoever believes that the environmental crisis can be overcome only through a radical reduction of human activity – less production, less consumption, even less data production - ends up with a state of emergency. If ecology walks in with an air of “Thou shalt not”, then it has already lost the cause. The great majority of people on this earth dream a very different dream. While Old Europe has lost its self-confidence and fears the sharp wind of globalization, they are striving for the achievements of modern life, which most of us long since take for granted. Nothing and no one is going to talk them out of this dream.

The truth is: if the developing countries carry out their economic pursuit according to the model that we have established, then things could end badly. In the European societies, with their sinking populations and growing numbers of elderly persons, demand is growing primarily for social and cultural services. In the lands of the South, however, it is concrete material growth that people want: housing, food, consumption goods of all sorts. To illustrate the magnitude of what we are talking about, let us look at the Chinese auto market. In 1990, 509 thousand vehicles were manufactured (automobiles, buses, trucks). In the year 2000 this number had risen to more than two million. After this production skyrocketed. Since 2009 China is worldwide Number One by a big margin. In 2011, more than eighteen million vehicles left the assembly lines, about three times as many as in Germany, the famous auto producer. It was the number of automobiles that rose most steeply. In 2010 there were 13.75 new automobile registrations – in Germany it is about three million per year, on average. And yet, passenger car density in China still lags far behind that of the highly industrialized countries. In Germany there are about 500 automobiles per 1,000

inhabitants, in China only about 77 autos. There is no immediate worry that China will attain German automobile density levels. In coming decades the automobile will lose its dominant position in the large cities, but outside of the metropolis there is still enormous potential for the growth of motor traffic. The Chinese government assumes that the number of motor vehicles will more than double by 2020. That would mean approximately 200 million motor vehicles in China. Rail and air traffic will increase dramatically at the same time. Yet China is only the trailblazer in this attempt by all of Asia to catch up with the industrialized world. Latin America and Africa are moving in the same direction.

The decisive question is not whether mobility is growing world-wide – that is not even being discussed anymore. The important consideration is how energy- and resource efficient the transportation systems and vehicles will be that carry billions of persons in short- and long distance travel. The simple multiplication of today's traffic volume would be the final fatal blow for the climate. The answer to this dilemma can only be to move in the direction of climatically neutral, resource-light mobility as soon as possible: rapid and comfortable public transportation networks, electric automobiles, airplanes that use biokerosene or hydrogen, and cities built for pedestrian and bicycle traffic. If we can succeed in increasing the energy efficiency of transportation by a factor of four – this is not witchcraft or voodoo! – we can cut carbon dioxide emissions by half, even with a simultaneous doubling of global traffic. To the extent that remaining energy requirements could be met by renewable energy sources, the goal of climatic neutrality would be within reach.¹³

What do we learn from this? We have to help the societies moving into the modern age to leapfrog the fossil fuel era as far as possible. In rural areas of Africa only ten percent of households have electricity. Lack of energy is the central obstacle to economic and

¹³ Ernst Ulrich von Weizäcker and his team furnish an abundance of concrete examples for the energy efficiency revolution of the twenty-first century. See: *Faktor fünf. Die Formel für nachhaltiges Wachstum*. Munich, 2010.

social development. Energy use on the continent is going to increase steeply, one way or the other, in coming decades. The decisive question is whether it will be coal and oil, or sun and wind that form the energy basis for Africa's economic boom. The developing countries still have the opportunity to build their cities, industries, energy production, and transportation systems in the most resource efficient ways possible. In order to do this, they need support in the forms of investment and technology. The chances for sustainable growth will increase if the prosperous industrialized nations lead the way. Europe possesses the scientific, technological and financial means to break the vicious cycle of economic growth and environmental destruction. We can reference positive experiences for this. The old industrialized nations have made great progress in improving environmental quality since the 1970's. Environmental pollution by harmful substances of all sorts has been reduced drastically. Rivers and forests have recovered; smog hanging over the cities has dissipated. We can tie in to this success story. In the next stage we have to decouple economic growth from resource consumption and carbon dioxide emission. Let no one say that this is impossible. The economic performance of the Federal Republic of Germany has grown by around one-third since the Berlin Wall fell in 1989. During the same period, carbon dioxide emissions were reduced by 25 percent. Impressive improvements in the resource efficiency of German industry, as well as the history of success of alternative energy forms, are hidden behind these numbers.

Germany has become a reference model for the idea that economic growth, better environmental quality and sinking emissions can go hand in hand. This is our most important message to developing nations. Why should Europe not participate in a growing world economy that includes an intelligent provision of services and sustainable products? Our strengths are knowledge and skills – the world can never have too much of either. How the fruits of growth are distributed is another matter. That is something which is decided in the course of the struggle for a just society. As we have seen during the last twenty years, growth is no guarantee of improved prosperity for the working classes. Nevertheless, a dynamic economic environment offers better chances for

upward mobility than does a period of economic stagnation. The fairy tale of “jobless growth” has been empirically refuted, and the financial situation of the social insurance sector mirrors the economic situation. Even enhanced tax financing for social services would not change the situation: tax receipts depend upon economic growth as well. Higher taxes for the “rich” can camouflage this connection only in the short term.

Synthesis of technology and nature

Until now the metabolic relationship between humankind and nature was the process of consumption of nature: the richer and more powerful the world of humans, the poorer was nature. This has been the case since the rise of the early empires, if not even earlier. The ancient Greeks and Romans stripped the forests of the Mediterranean region, to build their cities and fleets. What they left behind when their empires fell were bare, sunbaked landscapes. This way of dealing with nature has continued into modern times: the consumption of natural resources has never been so massive, greenhouse emissions so high, the extinction of species so intensive, as today. At the same time that the productive capacities of the industrialized nations have grown at a breakneck pace, the ecological systems upon which human civilization depends threaten to collapse. The rate of loss of “natural capital” increases proportionally with growing material affluence.¹⁴ Things cannot and will not continue like this. The overburdening of the central ecosystems that sustain human life will necessitate a change of direction. The pollution of the atmosphere by greenhouse gases will cause the climate to shift. Erosion and salination of the soil are causing the loss of fertile land at the same time that the demand for food and agricultural raw materials is growing.

We are standing at a turning point: either the great leap into sustainable types of production will succeed or our world is going to encounter severe crises. This is not just a question of new technologies, processes and products. What has to change is the

¹⁴ This is the argument of Paul Hawken, Amory Lovins and Hunter Lovins in their classic treatment *Natural Capitalism: The Next Industrial Revolution*. Washington DC: Earthscan, 2010.

relationship between human beings and nature. In future, we will be responsible for the natural world, not just for the world of humans. In the Anthropocene Age politics, entrepreneurship and the consumer will answer for climatic stability, biodiversity, protection of the seas, and the preservation of agricultural fertility. We have to take nature into our care. And so, in the twenty-first century, politics must become *geopolitics* in the true sense of the word.¹⁵ Such a geopolitics must declare the atmosphere, the oceans and the Arctic ecosystems to be global public goods, to be jointly administered. Humankind has long passed the point of letting the earth be as it is. We have, rather, to treat it like a giant landscape garden. A garden is arranged nature. Beauty and utility exist in symbiosis. In the farming areas and cultural landscapes of the Alpine territories, the wine-growing regions along the Rhein, and the hill country of Tuscany, such ideas have been practiced for centuries. They are landscapes shaped by farmers, classic examples of sustainable economy, conscious of the need to preserve the natural basis of production. With the emergence of large-scale industry a different viewpoint took hold that considered nature above all as a resource – an apparently inexhaustible store of raw materials and a place to dump the waste products of industrial society. The economy grew and grew by absorbing the treasures that lay hidden in the soil and the forests. What that industry gave back was garbage, exhaust fumes and waste water. Heedless exploitation of nature.

Today we are looking at a new paradigm shift: the transition to a form of economy that works with the productive forces of nature, rather than against them. Until now our image of nature has been shaped by the idea of scarce resources that have to be utilized as efficiently as possible: raw materials, fresh water reserves, fertile land, are finite things, and nature an ever more crowded habitat for a growing world population. This seems obvious, but is still a short-sighted way of looking at things. It is not the scarcity of limited resources but the fantastic productivity of nature, the incredible abundance of evolution that forms the basis for a sustainable economy. We do not yet

¹⁵ See Ernst Ulrich Weizsäcker: *Erdpolitik. Ökologische Realpolitik an der Schwelle zum Jahrhundert der Umwelt*. Darmstadt, 1989.

know the possibilities that will emerge from the combination of the creativity of nature and the human spirit, from the synergy of biosphere and noosphere.¹⁶ We begin to discern the contours of a green economy, in which biological evolution and technology enter into a productive synthesis. For these visions creative thinkers in the field of ecological politics have found concepts that give us a sense of what is involved: alliance technology [Allianztechnik] (Ernst Bloch), bio-cybernetics (Frederic Vester), efficiency revolution (Ernst Ulrich von Weizsäcker), natural capitalism (Amory and Hunter Lovins, Paul Hawken). Their model isn't a static society but a dynamic one, where we do not humbly fit into a pre-established natural order of things, but grow with nature.

The central productive force of post-fossil society is solar energy. When we hear the catchword solar energy we think primarily of solar electricity. We easily forget that the transformation of sunlight into carbon compounds represents the basis for all life upon the earth. From this originates the world of plants and microbes, upon which all other life forms depend. In the long term, ecological economy must build upon photosynthesis as the source of biological and chemical basic materials. Biotechnology will become the leading technology of the twenty-first century. New techniques, materials and products will imitate the "inventions" that evolution has produced over the course of millions of years.

At the same time, it will be necessary to constantly improve resource efficiency. The old green slogan "Less is more" is taking on a new meaning: to produce more prosperity from less primary energy and raw materials. This sounds a little like alchemy, but it is no witchcraft. The chemical industry has already demonstrated how production can be increased while reducing the use of resources. It has taken further than other economic sectors the principle of closed material cycles and cascade utilization of raw materials. The question is often raised why German industry is so well placed in world markets.

¹⁶ The concept "noosphere", derived from the ancient Greek term for spirit, was introduced by the Russian geochemist Vladimir Ivanovich Vernadski in the 1920's. In the 1970's the media theoretician Marshall McLuhan used the term in referring to the worldwide network of electronic information systems, which "form a technological brain for the world."

Resource efficiency is certain one of the factors contributing to success. The slogan is: end up in the black with green products. In the last twenty years the Federal Republic has become a model for how a highly industrialized society can reduce its carbon dioxide emissions without going broke. The German "energy shift" is a global reference project. Many people around the world are looking closely at how Germany is solving the adjustment problems resulting from the rapid increase of renewable energies. If Germany succeeds in continuing this transformation successfully, many others will follow. For this reason it is vital that we follow this path to its final destination.

Against eco-pessimism

Ecological discussion is traditionally characterized by two words: dangers and limits. There are good reasons for this. Sometimes it is absolutely necessary to cry "Fire!" if we want to break through the routine of "Keep it up" and wake up the public. But hitting the panic button without presenting alternatives desensitizes people over time. If we hope to win over citizens, businesses, city councils and governments for ecological change, we have to be ready to talk about chances and possibilities. The debate about atomic energy is an instructive example. There has been a strong anti-nuclear energy movement in the Federal Republic since the 1970's. Since the catastrophe in Chernobyl in April, 1986 the potential dangers of atomic energy have been obvious to all. But it took more than twenty years before the strange idea of producing steam by means of a nuclear chain reaction was finally packed up and gotten rid of by the politicians. The federal government had just concluded the extension of life spans for nuclear power plants when the Fukushima atomic power plant went out of control. Always sensitive to how the wind is blowing, Chancellor Angela Merkel announced a new reversal of policy and immediately shut down half of the existing German nuclear reactors. Protests from the economic sector were barely audible. No one uttered a warning that the lights would be going out the next day. This was all possible only because – in contrast to 1986 – there was a broadly supported alternative to nuclear energy: renewable

energies. Wind power and solar electricity had already passed the test. In the time since the red-green coalition had passed the Renewable Energy Act in 2000 a new branch of industry had come into being, employing hundreds of thousands of people. Broad segments of the public were (and are) convinced that this is the future of energy provision.

The exit from nuclear energy was not just an act of averting danger. It was a move forward into a new, fascinating age of renewable energies, the beginning of a green revolution. There is no ready-written script for this. When the ecological shift begins it will create its own dynamic. The number of inventions will increase, new technologies will appear, venture capital will flow into new business enterprises, new markets will open. Things that were science fiction yesterday are being trumped by reality today. Who could have imagined thirty years ago the kind of world we are living in today? Since then the Soviet Union has collapsed, the Berlin Wall has fallen, and the Iron Curtain is ancient history. China has become a world power. The German mark has landed on the scrap heap. German forests did not die out. Salmon are swimming in the Rhein again. The digital revolution fundamentally altered economics, politics and everyday life. Germany became a groundbreaker in wind- and solar energy. The Arab world, long the epitome of stagnation, has become the center of a political whirlwind. In other words: you cannot predict the future on the basis of the present. We cannot be sure that "everything will be fine" nor do we have to give up the idea of progress. We simply have to give it a new definition. If ecologists spend all of their energy and passion decrying the future as a disaster they will ultimately achieve nothing. The public will experience a somewhat pleasant shiver of fright, will nod its head in agreement, and continue doing exactly what it has always done. A dynamic of change can only emerge if we succeed in depicting the opportunities for a better future that lie hidden behind the risks.

Those who promote the idea of a green industrial revolution run the risk of being dismissed as indulging a naïve faith in technology. Even hardnosed critics of civilization

concede that we cannot survive without some technological innovations. Their concessions, however, are merely light repairs to the Titanic. For them, the real challenge is not change in ways of production but change in the habits, desires and behavior of human beings. The immoderate Saul has to become a moderate Paul. Whatever we might think of such penitential sermons, if we look at the situation soberly we are bound to come to the conclusion that simply foregoing consumption will not save the planet. There are too many of us in the world for that to work. Tens of millions more are added every year, all striving for the achievements of the modern age. We cannot undo the measure of individuality, mobility, comfort, communication and plurality of life styles that characterizes modern society. Promoted as a political program, the minimization of production and consumption would result in an authoritarian, tyrannical reign of virtue in the name of ecology. We really shouldn't go there. The object of ecological politics is not the modification of human beings but the alteration of industrial society.

Is the debate about lifestyles irrelevant? Can we rely upon technological innovation alone? Absolutely not. Changes in our everyday behavior and the industrial-technological revolution go hand in hand. The time of unthinking consumption is over. We have to assume responsibility for the consequences of our actions. It isn't just the notated price of a product that is important but also the social and ecological effects that it entails. Nowhere is this seen more clearly than with our food products. What we eat does much more than simply influence our wellbeing. It also affects land usage, cultivation methods, animal husbandry, water usage, transportation and carbon dioxide emissions around the world. It is our hunger for meat- and dairy products, not "international agriculture capital's greed for profit," that is the biggest driving force behind the industrialization of agriculture. When a growing number of people reach for poultry, beef, salami, yoghurt and milkshakes in the supermarket, they are supporting mass livestock farming. Because of this an increasing proportion of grain production has to be diverted for use as animal feed. The prices for basic foodstuffs rise. Pressure for more intensive land cultivation increases. Those who complain about the transformation

of cows, pigs and chickens into mere biomachines, and are appalled by monster livestock pens containing thousands of animals, need to start questioning their own food choices: perhaps less meat, more grains, beans and peas, fresh fruit, vegetables. If you embrace this kind of diet, you will discover that you haven't lost anything. Eating a good piece of meat only now and then is not the same thing as giving up the joy of eating. You gain the pleasures and advantages of vegetarian cuisine in the bargain. You are not so much giving something up as gaining a new kind of pleasure.

Even a change in our ideas of good dining is not going to change agriculture into a kind of fairy tale farm, however. Global demand for food is bound to increase. Agricultural raw materials are also becoming more important for industry and the energy field. Pressure upon agriculture, the soil, and water reserves will further intensify. Our individual behavior is only part of the solution. We will not master these problems without political reforms and scientific innovations. Apart from how our personal attitudes factor into this: it is always right to act in such a way that we do not cause suffering to another living being. "Fair Trade", ethical consumption and sustainable investment are more than fads. They are precursors of a new economy. The more people who think about the consequences of their lifestyles, the more leverage they will obtain.

Only in a collaboration between technological innovation, political management and individual behavior can ecological transformation emerge with the depth, breadth and speed necessary to avoid sliding into crisis and upheaval. Whether we will manage this is still quite uncertain. It may be that in the next few decades the earth will become an inhospitable place, "hot, arid, and hostile", as the journal *Zeit* has prophesied.¹⁷ That is an open wager. Even if it should prove to be too late to limit the greenhouse effect to 2 degrees Celsius, however, we should pull out all the stops to reduce carbon dioxide

¹⁷ Frank Drieschner: "Der große Selbstbetrug", <http://www.zeit.de/2012/41/Vier-Grad-Klimapolitik-Klimawandel/komplettansicht>.

emissions as drastically as is humanly possible. The better we succeed the better able coming generations will be to adjust to climate change and to begin to cool off the earth again.¹⁸ We have reached a point where we must engage in a three-pronged strategy: maximum reduction of new greenhouse gas emissions – removal of carbon concentrations already accumulated in the atmosphere – best possible adjustment to unavoidable climate changes. No strategy of innovation, however successful, and no cultural and political reformation will produce a harmonious, crisis-free future. A world containing nine billion human beings is not going to be idyllic. Nevertheless, we must do everything within our power to channel progress in a new direction, and to avoid a social Darwinian “every man for himself.”

¹⁸ See Hans-Josef Fell: *Global Cooling. Strategies for Climate Protection*. Leiden, NL/New York: CRC Press/Balkema, 2012.