



s.m.a.r.t.

*Paths to
Sustainability*

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This book has been possible thanks to 34 authors from five continents, specialized in economics, environment, architecture, landscape architecture, politics, finances, photography, arts, communications and culture, who have joined their names in this project for sustainability.

Foreword

It is possible to progress while preserving the planet

The notion of “sustainability” impregnates the agendas of public and private organizations, political parties, firms, NGOs, and social players of all kinds. From Mexico City to Sydney, Dubai to Madrid, there is a shared concern about the severe challenges we face as a consequence of climate change and other global phenomena that threaten the equilibrium of our planet. Our lands are rapidly turning into deserts. Our cities are increasingly overpopulated and polluted. Water is a natural resource that is growing scarcer over time. Throughout our history, economic growth has been irremediably linked to the deterioration of the planet’s environmental conditions. Something must change.

Not without great effort, we have managed to generate an ample consensus in recent years that it is now “essential” for our societies to change direction toward a more sustainable world that will give rise to a new economic and social model.

However, the concept of “sustainability” in itself can prove ambiguous. It is continually used, and often imprecisely. We risk emptying it of content.

This is where the idea of **s.m.a.r.t.** comes in, a proposal that takes material form in the magnificent and highly informed contributions to this volume. It is an acronym that encompasses the elements of an integral vision of the future based not only on the notion of sustainability itself, but also on **mitigation**, **adaptation**, **resilience** and the **transformation** of societies.

For without **sustainability**, progress will be simply impossible. A collective effort is necessary for the **mitigation** of the harmful effects of our activity, by reducing greenhouse gas emissions through clean energies, for example, or by ensuring a more reasonable and efficient management of water. Initiatives are needed to encourage the **adaptation** of communities to the consequences of global warming by means of infrastructures capable of withstanding the greater frequency and intensity of extreme meteorological phenomena. In this way, we shall help equip the societies we live in and whose services we provide with the **resilience** necessary to confront these hurdles. Finally, our response to these challenges has a clear objective: the **transformation** of the world into a safer and more balanced planet.

Much can be done by firms both large and small in pursuing these ambitious goals. At ACCIONA, we are committed to this new **s.m.a.r.t.** model of development, which takes sustainability as the basis for specific actions aimed at mitigation, adaptation, resilience and transformation. It is a formula that can make economic growth compatible with the decarbonization of our economies, for our own benefit and, above all, that of future generations. That is our proposal, and that is what the book in your hands is about.

I have not only the hope but also the firm conviction that more and more players and organizations will embrace the **s.m.a.r.t.** criteria and join us in this new “sector”, whose guiding principle is precisely to contribute to an increasingly sustainable society and world.

*José Manuel Entrecanales,
Chairman of ACCIONA*

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Introduction

A Common Agenda at Last

Ours can be the generation that ends poverty, achieves social justice in the allocation of basic needs, and finally brings global warming and the loss of biodiversity under control

Jeffrey D. Sachs

Energy is the central nucleus of this response, but not the only one. Changing soil use, deforestation, agriculture and livestock farming make up the other battlefield in which our future is at stake

Teresa Ribera

Paths to Sustainability

Jeffrey D. Sachs

“It was the best of times, it was the worst of times.” Charles Dickens’ immortal characterization of the French Revolution applies equally to our own time. It was the best of times: global poverty is at an all-time low, and life expectancy is at an all-time high. It was the worst of times: humanity is creating an environmental disaster by its own hands. So, which is it? Both. And what does the future portend? That depends on us. Our fate is squarely in our own hands on this one.

Here’s another description, this one by the great biologist E. O. Wilson: “We have created a Star Wars civilization, with Stone Age emotions, medieval institutions, and godlike technology. We thrash about. We are terribly confused by the mere fact of our existence, and a danger to ourselves and to the rest of life.” The problem, in this view, is that our wondrous technologies, the ones that are ending poverty and extending life, are also running far faster than our emotional development and institutional capacities to control them.

And here is a third, by Pope Francis, in his remarkable encyclical *Laudato si’*: “Interdependence obliges us to think of one world with a common plan. Yet, the same ingenuity which has brought about enormous technological progress has so far proved incapable of finding effective ways of dealing with grave environmental and social problems worldwide. A global consensus is essential for confronting the deeper problems, which cannot be resolved by unilateral actions on the part of individual countries.”

We have, indeed, a political consensus on the key challenge, and it takes the name “sustainable development.” On September 25, 2015, all 193 member states of the United Nations adopted the 2030 Agenda for Sustainable Development, and with it, the Seventeen Sustainable Development Goals (SDGs) shown in figure 1. By sustainable development, the UN member states mean an economy that is simultaneously prosperous, equitable, and environmentally sustainable.

I have recently described these three goals as “smart, fair, and sustainable.” Smart, today, means the deployment of advanced information technologies that save us from backbreaking labor and enable us to share knowledge and crucial information with all parts of the world on a nearly instantaneous basis. Smart economies can escape from poverty and leapfrog in health, education, and quality of life. Fair means that the benefits of modern technology are widely shared, that, in the words of the UN, “no one is left behind.” Extreme poverty is an

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anachronism in a world economy that produces \$125 trillion annually, with an average output per person of \$16,600 (IMF estimates for 2017). And sustainable means living within “planetary boundaries,” that is, keeping the world economy within safe operating limits regarding the uses of vital resources, including water, land, and biodiversity. The main planetary boundaries are famously depicted in figure 2, emphasizing the dangers to the climate, ozone level, freshwater, biodiversity, and other parts of the Earth’s systems.

To achieve sustainable development we need a new global systems thinking, one that combines a deep knowledge of four separate subsystems: the techno-economic system that has produced vast wealth with the “godlike” technologies; the political system that is essential for providing the public goods that underpin the economy and for sharing the benefits of modern technology; the social system, that determines whether social groups—often divided by language, race, culture, and religion—cooperate or fight. And the Earth systems, including the water, carbon, and nitrogen cycles that humanity has disturbed and degraded at our peril.

We currently lack such systems thinking. Many people are unaware of the underlying techno-economic systems that enable us to manage an economy of 7.5 billion people at such a high level of average performance. Very few people understand the underlying technologies of the Internet, mobile telephony, aviation, disease prevention and control, food production and distribution, power generation and distribution, finance and payments, and much more, which make the system function. And experts in one domain are very rarely expert in others.

Despite the fact that we are all political animals (to paraphrase Aristotle) and live within political systems, we lack a good understanding of how politics can and should produce sustainable development in our time. As Wilson correctly notes, our institutions are medieval. America’s constitution, a remarkable intellectual achievement, is from 1787. It works, but it also creaks today, unable to deliver wellbeing on a reliable basis for the American people.

And though we are all physically part of the biosphere itself, and are naturally drawn toward it (according to Wilson’s theory of *biophilia*), much of humanity is hardly aware that we are destroying it. We are at grave threat of trespassing all the planetary boundaries, with consequences that could be dire. One major characteristic of Earth systems is their nonlinearity.

We could easily find ourselves in the midst of rapid and uncontrollable physical change. Another major characteristic is irreversibility (or hysteresis), the property that a physical system can swing from one state to another on a long-term basis. We could soon find ourselves, for example, with a several-meter rise of the sea level as the result of the disintegration of parts of the Antarctic and Greenland ice sheets due to human-induced global warming. And if that occurs, there is almost surely no return to lower sea levels for millennia afterward.

Perhaps the system we are least in control of these days is the social system. It is a depressing fact that as the world economy has become global, our Stone Age instincts to view the world as “Us versus Them” seems also to be on the rise. For several decades following the atrocities of Hitler it seemed that nationalism was kept at bay, at least to some extent. But now vulgar nationalism is resurging, marked by the primitive utterances of right-wing nationalist politicians that are emerging in many countries, most notably and dangerously in the United States.

Wilson has helped us to understand these primitive and dangerous intergroup emotions. According to him, and Darwin before him, human traits were probably forged in the context of “two-level” natural selection. At one level, individuals (and their genes) competed within localized communities. At another level, groups of individuals (bands of hunter-gatherers) competed with each other. The result: strong norms of in-group cooperation (e.g. for a successful hunt) as well as strong norms of intergroup rivalry and distrust forged in repeated wars and competition for land.

What can we achieve if we understand and properly manage these four interacting systems, the techno-economic, political, social, and environmental? We can achieve sustainable development. Indeed, ours can be the generation that ends poverty, achieves social justice in the allocation of basic needs, and finally brings global warming and the loss of biodiversity under control. The best of times. And if we fail to understand these systems and control them? The worst of times.

So, in this sense, the SDGs are first and foremost a global homework assignment: learn about the global technological, political, social, and environmental systems, and propose ways to manage them to achieve seventeen goals by 2030. I tell my students that their homework assignment indeed is “to end poverty, produce social justice, and stop climate change by 2030.” When

We must help the world to perceive the challenge of sustainable development and overcome the normal profit motives

they panic, I remind them that the assignment is open-book; that they can (and must) work in groups; and that the homework is due in thirteen years rather than next weekend or the next election. The homework is tough but fair. And everybody can pass.

Here are some hints on the answers.

First, the techno-economic systems are now so powerful, and becoming even more so (with artificial intelligence, advanced robotics, atomic-scale manufacturing, and more) that the seventeen SDGs are truly in reach. The issue is mobilizing the resources and expertise to achieve them: and not just in a few leading countries, but all over the world. My colleagues and I have made repeated calculations concerning how much it would cost to achieve sustainable development, in terms of increased investments in fighting poverty, ensuring universal access to healthcare and education, shifting from high-carbon to low-carbon energy to head off global warming, and protecting threatened marine and terrestrial habitats. The best guess that we have come to is that the shift of global resources needed is on the order of 2–3 percent of global output per year, or roughly \$3 trillion. That may sound like a hefty sum, and it is, but it is a hefty sum within a huge and rich global economy. It is a sum easily within reach through taxes, markets, foreign assistance, and other methods of mobilizing and transferring financial resources.

Second, success in achieving the SDGs requires the mobilization of expert knowledge within a multi-stakeholder setting. There is no better way to understand how to control HIV/AIDS than to ask HIV/AIDS experts. There is no better way to understand how to decarbonize the energy system than to ask engineers expert in energy systems. That may seem obvious, but how rarely our society acts that way. We are bombarded by the foolish opinions of pundits, politicians, and blowhards when real evidence is easily within reach at universities, think tanks, and academies of science and engineering. Yet the experts must interact not only with each other but with all key stakeholders, including civil society, businesses, and government. We need the knowledge of experts mobilized in ways that are fair and trusted by society at large.

Third, success requires sustained and planned efforts over many years or decades. Ensuring that every child can achieve a secondary education (SDG 4) will require at least five years of sustained investments in many low-income countries. The same is true of universal health coverage (SDG 3). The conversion of today's energy

systems to low-carbon systems will require thirty to fifty years in view of the long lives of our infrastructure and the long lead times needed for large-scale investments in energy systems. I am constantly reminded, and inspired, by the US moonshot of the 1960s. In under nine years the US went from its first man in space to its first astronaut walking on the moon and returning safely to Earth. America put its best engineering minds to work to accomplish that miracle, and put significant financial resources into the effort for an entire decade.

I regard two issues to be our very greatest obstacles to overcome, and they are neither technical nor financial. The first is our limited attention span as individuals and as a society. Humans by nature have limited attention spans, and in our media-drenched age, advertisers, politicians, and celebrities all fight to capture that limited attention. So, a major first-order challenge is to help the world to perceive the challenge of sustainable development. The SDGs were adopted by governments, in part, with that very challenge in mind. But we need more than individual attention; we need social attention, meaning that our political, social, business, and academic institutions give adequate focus to the SDGs as well.

Figure 1. The Sustainable Development Goals

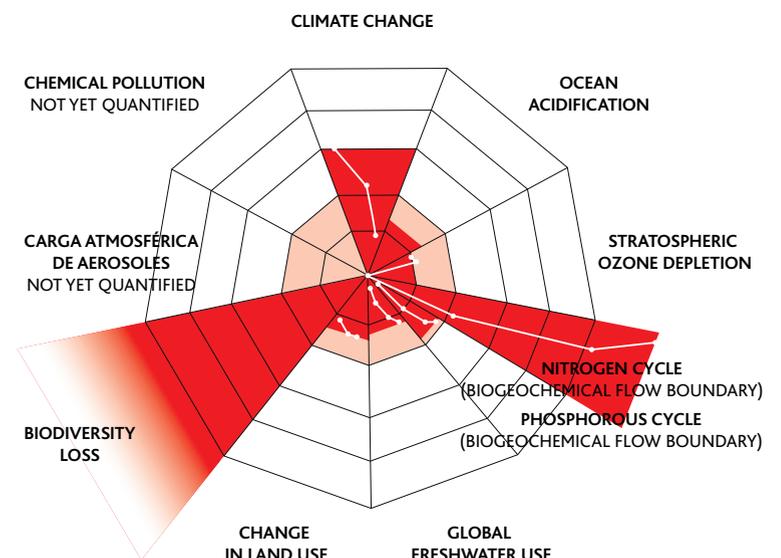


The second is moral. To achieve sustainable development, we must overcome the normal profit motives. We must say to oil and gas companies: stop your drilling. We must say to the rich: pay your taxes and share your wealth. We must say to ranchers and farmers: you must not cut down the rainforest to expand the cattle ranch or plantation. We must say to the world's leading businesses: your shareholders come second to Earth itself. We must say to the politicians: your hold on power pales in importance to sustainable development itself.

This is our greatest challenge. When Donald Trump says America First, we must say no! Earth First, Decency First, Sustainable Development First.

We can do it. The lessons in this important volume by Acciona show us the way.

Figure 2. Planetary boundaries



The Paris Agreement: Horizon of a New Economy

Teresa Ribera

The alarms have gone off on many fronts, and the sensation is spreading that we are in the middle of a difficult race against the clock. “We’ve known about this for decades, and the problem seems to be getting worse and worse,” says Leonardo DiCaprio in his documentary *Before the Flood*.

Today, more than ever, recognition is due to the environmentalists and scientists determined to seek joint strategies for tackling climate change. It has taken us forty years to realize that only on the basis of a dense network of mutual understanding and support among energy suppliers, financiers, government leaders and social and economic agents of very different kinds can we come up with an adequate response to the great challenge ahead of us. It will otherwise be impossible to generate the transversal response that is required, and instead we shall have only small marginal adjustments, barely enough for a temporary palliation of the need to act.

Now that the importance of climate change is beyond all doubt, the Paris Agreement offers an innovative proposal on how to arbitrate effective mechanisms of governance to confront it on a global scale. Perhaps because we have realized there is no alternative, or because of the firmness with which heads of state and governments have put forward their convictions, or simply because of the unstoppable evolution of social demands, there are certainly interesting signs after the adoption of the Paris Agreement of a profound change in patterns of investment and economic activity.

The adoption of the accord in December 2015 took the world by surprise, since it went further than anyone familiar with the process had imagined beforehand. Moreover, its implementation has broken records, showing that when there is strong political commitment, it is possible to make changes in a short time. Paris represents hope and willingness, but it admits of no delay or carelessness. It points to new mechanisms and helps to recover confidence in our collective capacity to change things, but it warns of its own insufficiency and calls for a constant tension that still awaits consolidation. Confirmation is still pending of the most important thing of all, namely its capability to create a different dynamic of development, bolstering the confidence of our societies in their ability to do things differently by ensuring a future low in greenhouse gas emissions and resilient to the effects of climate change.

In the context of a planet with more human beings and the same resources, solving the equation that will allow a reasonable level of prosperity for all while avoiding the

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dangers of climate change requires a transition to a different economy. This is the commitment undertaken in Paris. To be able to work against climate change and in favor of the eradication of poverty and the achievement of the goals of sustainable development, the average temperature of the planet must not be allowed to rise by more than 2°C with respect to the pre-industrial era (and efforts should be made to restrict the rise to 1.5°C), our capacity for adaptation and resilience must be strengthened, and it must finally be ensured that financial flows are compatible with these two goals. In other words, there will be no lasting development or eradication of poverty on a planet that is two degrees warmer. And the time has come to start to understand what that means and how it can be prevented.

We are now beginning a new phase in which the emphasis needs to be placed on action. How to impel the transition to a new economic model that must of necessity be “ecological”? The countdown has already begun for the achievement of a triple objective with profound implications for the economic model.

Given its responsibility in the causes behind climate change and its undeniable relation to human development and well-being, energy becomes the priority target for climatic action, and so also an area of real and perceptible change. It changes where demand grows, and also where there is finance to invest in it. This shakes up traditional suppliers and stimulates innovation. We are now witnessing a succession of announcements by very different agents: China is canceling new coal projects; numerous long-term investment funds are withdrawing investment from fossil fuels, demanding much more serious attention to the evaluation of risks, or even threatening to veto decisions that show an irresponsible neglect of climatic risk; there is an (uneven) effort among industrial players, who are announcing commitments on which they are prepared to report rigorously and transparently; and we were surprised to hear talk of revolution from traditional institutions and accredited observers in the field, such as the International Energy Agency, which put forward scenarios and prospects that differed greatly from those of barely a decade ago. We are fascinated by innovative and enterprising enthusiasts for novel solutions like electric mobility (preaching a speedier end to the hegemony of petroleum), solar roofs, and alternative ways to accumulate energy. And we impatiently await the response of financial regulators, who have announced their intention to favor more rigorous risk evaluation frameworks that will

incorporate and discriminate what until not long ago went unnoticed: the immense cost—and consequent risk—generated by greenhouse gas emissions.

It is a complex puzzle with many pieces, many of which are starting to change shape. Winning the battle against climate change means decarbonizing energy, which makes it essential to generalize energy efficiency and carbon-free solutions. There is a large range of technical options available, and a huge deficit in our capacity to assume them, which is not accompanied by the regulatory frameworks and signals on which we base the rationality of our decisions. It remains easier and more comfortable to opt for conventional solutions, and even so, ground is starting to be gained by a new way of measuring expected profits, and it is beginning to make economic sense to invest in efficient and renewable alternatives!

Paris has meant a first exercise in diagnosis and commitment for each of the 196 countries that form part of the multilateral system, but it remains an instrument for achieving the goal of a coordinated and effective response that must materialize on every front. Energy is the central nucleus of this response, but not the only one. Changing soil use, deforestation, agriculture and livestock farming make up the other battlefield in which our future is at stake.

Since the agreement represents only the first step, the measures already identified by each signatory must be implemented at once, and favorable conditions must be created for the generalization of those which prove effective while boosting regional and sectorial action in different areas. Examples that ought to inspire us when it comes to establishing priorities are an aviation industry committed to the reduction of emissions, a maritime transport sector that assumes its responsibility, cities, service providers and mayors committed to different urban models, and citizens applying and demanding different products and policies. The coming decade is decisive. It will be the one that makes the difference between a real possibility of slowing down climate change or the road to unprecedented disaster.

While we may be in the middle of an unfinished race against the clock, it is also important to activate the tools that will prove most effective for accelerating change. We cannot permit ourselves the luxury of failing to take advantage of resources or compounding the problem, and so the signals that orient investment decisions have to be clear and coherent. We must learn to evaluate risks and benefits differently, and for this we need tools that help

Paris represents hope and willingness, it points to new mechanisms and helps to recover confidence in our collective capacity to change things, but it warns of its own insufficiency and calls for a constant tension that still awaits consolidation

to show the cost (damage) caused by the emission of greenhouse gases in terms of a price or a rate, greater transparency with respect to the characteristics of the risks faced and the means necessary to palliate them, rating agencies with the ability to assess them, financial instruments that make low-emission investment attractive, and a beneficial use of the resort to debt or bond issues by associating the application of resources with a particular goal, as exemplified by “green bonds” and “climatic bonds.” Perhaps this is one of the greatest revolutions currently under way. Development banking (headed by those of China and Brazil), long-term investors, commercial banks and the insurance and reinsurance industry are currently immersed in this task. Some countries such as France and the United Kingdom have already adopted mandatory reporting rules or even limitations on public institutions. There is a growing conviction that for success to be achieved in this enterprise, it is of prime importance to foster coherence among the signals that orient any public or private investment decision. But it is not easy to reorient the functioning of financial systems that have been operative for decades. Ethical challenges are among the components of the increasing level of analytical sophistication introduced by academics, regulators and financial agents. So are effective instruments which allow losses to be anticipated and risk reduction on operations to be incentivized, or which make the cost or damage that will foreseeably be generated in the future visible today, together with the acceptance of margins of uncertainty in novel contexts. Nevertheless, it is worth drawing special attention to the work carried out by the Financial Stability Board at the express commission of the G20, with the support of a working group co-chaired by Michael Bloomberg and AXA, dedicated to the assessment of alternatives that would ensure climatic risks were taken more into consideration.

On the other hand, in order to anticipate rational decisions, fully compatible with the climatic challenge, and prevent short-term pressure from diverting us from the Paris objectives or making them hard to achieve, we are obliged to generalize the use of retrospective scenarios and backcasting techniques. Setting a clear goal for 2050, and proposing scenarios in which different combinations of measures would ensure its fulfillment, is a good way to promote a debate on how to structure the transition, securing coherence between short-term decisions and the vital goal of decarbonization. Understanding this, the Paris Agreement invites signatories to share any national progress that shows how the main socioeconomic

objectives can be reconciled in the domestic sphere with the processes of decarbonization and resilience. Not that such techniques should be understood as applicable only to states. Sub-national governments and boards of directors may also find them useful instruments for taking complex decisions. A good understanding of the alternatives will be decisive for the question the Paris Agreement proposes addressing by 2020–2023: how to cover the breach between the measures and commitments announced in 2015 and the objective of staying under a temperature increase of 1.5°C–2°C, equivalent to zero (or negative) emissions before the end of the century. Here again, the prior political orientation of the leaders of the G20, which will be under German presidency in 2017, seems of capital importance for fueling an informed political discussion on how to guarantee fulfillment of climatic commitments, and also for fostering coherent decisions on questions of investment and infrastructures. It is not possible to promote strategies of economic recovery or investments in infrastructures based on the reading of an unviable model. For example, what additional port capacity is needed in a world where carbon, petroleum and gas transport is bound to decline? What terrestrial mobility is needed, and what supporting infrastructures would facilitate it? What consumption and what urban services are required by a carbon-neutral society resilient to climate change? And so on.

The construction of a new economic horizon after the Paris Agreement goes beyond its technological and financial implications, beyond the fiscal system and beyond the use of good planning techniques. It also requires the incorporation of the obligations that accompany the effects of climate change so that answers can be anticipated for a reality we can glimpse today, with changes in hydrometeorological patterns affecting both infrastructures and demand for services, and with impacts on the physical conditions of the territory, on crop yields (and so on the welfare of much of the world's population), on migratory movements or tensions within or across borders, and on markets for raw materials. It would be illusory to suppose that a defensive strategy which eluded these changes could be a success. A systemic reading of the Paris Agreement therefore obliges us to reinforce our knowledge of the vulnerabilities that need to be addressed.

In this respect, two significant conclusions should be highlighted. The first is that in a closely interdependent world, economic and social prosperity and the prospect of development and economic activity beyond the OECD

countries are critical for humanity as a whole. The matter of climatic vulnerability therefore needs to be taken seriously if we want a better understanding of the real prospects of success and return on any investment, public or private. Finally, it is essential to reinforce solidarity, both between and within countries, with the social groups most vulnerable to the effects of climate change and/or the change in production model. This is not only for ethical or moral reasons, important though these are, but also because of the negative economic effect of a lack of suitable strategies for those who regard themselves *a priori* as losers, and who see no choice but to resist change or fight for survival. A greater role needs to be played in this case by public institutions, but it is not their exclusive concern, nor is it reasonable that civil society should refuse to be involved in this process.

Paris may be insufficient, but it is certainly a useful tool for accompanying the construction of a new economic horizon, a twenty-first century necessity that must not be renounced.

To attend to the need for dwellings in cities, not only do the slum dwellers already living there have to be rehoused in better conditions, but allowances also have to be made for the rapid formation of new dwellings

Joan MacDonald

1. *The Social Dimension of Sustainability*

Global companies are adopting circular production systems, moving away from produce-use-discard dynamics in favor of produce-use-reuse ones and circular service systems

Marek Harsdorff

The undernourished population now numbers 868 million people, and 2,000 million suffer from some form of micronutrient deficiency

Paolo Bifani

Hands That Build Cities

Joan MacDonald

Surviving in the City

To be able to lead their everyday life, human beings need to condition their environment. They must furnish themselves with the materials necessary for separating off a domestic ambience which will afford them a certain degree of comfort. From their psychological, social and cultural reality, requirements also arise, which they will seek to satisfy in their habitat as individuals, couples, family groups or neighborhood communities. If they live in the city, they will moreover attempt to have easy access to its networks of services, and will try to remain close to urban facilities and the work opportunities they provide. Most people also hope that their dwellings will be available for reasonably long periods of time and in relatively safe places, so that their family and neighborhood life can go by without too many unexpected upheavals. These are simple concrete aspirations that we all seek to fulfill in a satisfactory dwelling. Nevertheless, many citizens, and especially the poorest, are unable to own dwellings that respond even remotely to these conditions.

It is difficult and tough for the poor to survive in today's city. They can perhaps construct a basic lodging with the few resources they possess, as their forefathers did. But it will be harder and harder for them to find a place to build it. While they might once have risked occupying "residual" spaces, such as the banks of watercourses or steep hillsides, modern urban planning now forbids them to settle there for reasons they perhaps cannot even understand. The "safe" and legal land of the city is now occupied or reserved for other ends, or for those who can pay for it. Urban services—water, sewage, electricity, mobility—do not reach the remote or forbidden places where they have had to settle, and they can be moved out of those places at any time if they lack legal entitlement to the land they occupy.

The most widespread physical expression of a precarious human habitat is the slum. Such settlements, whose names and characteristics vary, are beset by deficiencies, whether jointly or in isolation, such as uncertain permanence, a lack of basic services, small dwellings of poor quality, and overpopulation and crowding. One out of every three inhabitants of cities in the developing world lives in a slum. The proportion of people in slums has diminished with the advance of urbanization, but the same is not true of the volume of the population living in such conditions. More and more inhabitants will have to live, or at least survive, without a minimum degree of comfort, health and safety.

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From the point of view of habitation, then, the panorama is not improving but growing steadily more dramatic. Not only do the slum dwellers already living there have to be rehoused in better conditions, but allowances also have to be made for the rapid formation of new dwellings. Since efforts so far to reduce the housing shortage, or at least to prevent it from worsening, do not appear to have been especially effective, it is worth wondering whether we should accept that a dwelling is a privilege reserved for a few, while a large proportion of mankind is condemned never to have one. Or are we perhaps understanding and handling the matter wrongly?

Mass Production of Dwellings

From a conventional point of view, a significant increase in the production of dwellings has so far been the only—or at least the principal—way to confront the phenomenon of precarious habitats. Unlike other social policies, public housing has preferred to focus on what can or should be done from the supply side rather than tackling the issue on the basis of the inhabitants' needs. Governments and construction firms agree to build massed housing, which they believe to be a suitable and definitive solution to the problem. For the purpose, they have consolidated an institutional, entrepreneurial, professional and financial apparatus “specialized” in the production of cheap dwellings, and they have instituted procedures, norms, prohibitions, permits, strategies and programs to this effect. The client—or beneficiary, if the dwelling is adjudicated or subsidized—has little choice in the matter, since it is believed that the client's intervention would only complicate and delay a task that should be left to the specialists to accomplish.

Precarious or Informal?

Given the modest results obtained with the application of this conventional focus, we propose to open a discussion on its validity. To begin with, it does not seem right to equate precariousness with the existence of slums, or to ascertain its dimensions on the basis of the population living in these settlements. Not every aspect of precarious living is expressed by slums, which are otherwise so diverse in their potential for development that we cannot affirm that all are necessarily precarious, or will continue to be so. Further, it is debatable that such negative connotations should be ascribed to the only answer the poor have been able to give to a need that the organizations of the housing sector have been incapable

of meeting. When seen from this perspective, the figure of one in three inhabitants of the cities of the south living in slums appears to highlight the formidable success of the poor in confronting their lack of habitation.

From the conventional camp, it is argued that what “informal” builders construct are not dwellings but shacks with no material value, which merely aggravates the problem. For the poor, however, the material is only one aspect of a home. They attach more importance to opportunity, since finding accommodation is not an option that can be postponed until a dwelling is given to them, but has to be solved on a day-to-day basis. They also appreciate a well-located dwelling, near sources of income or adjacent to those of family and friends, in order to have support and construct social capital. They agree on the importance of access to basic services, but will reserve the right not to have them installed in their dwellings “for the time being,” or perhaps to share them with neighbors. If we insist on the deficient materiality of informal housing, they will tell us that their home is rather small or flimsy “for the time being,” but that they will do it up in time and enlarge it as much as their possibilities allow. For them, a dwelling is “the place they are living in,” here and now, and not merely the inhabited building. By combining hard components, such as walls, floors, ceilings, courtyards and streets, with a range of “soft” components, such as proceedings, actions, experiences, opportunities, acquired knowledge and collaborations, according to their particular dreams, priorities and motivations, they create, improve and broaden their domestic environment from one day to the next.

Product and Process

The process of conditioning that goes under the misnomer of informal therefore has nothing precarious about it. It is complex, dynamic and efficient given the scant resources and the limitations within which it is accomplished. It is a process that contributes to urban sustainability because it carefully faces up to events with a view to responding to them in the best possible way. Indeed, in most slums the inhabitants attach value to dwellings the formal sector would probably ignore. A house may be cheap and badly built, but it is never worth nothing.

When dwellings are regarded from the point of view of the processes of habitation developed by their inhabitants rather than the product we obstinately try to impose on them, various routes open up that are very different from those followed by conventional social housing programs.

The generation and diffusion of knowledge and skills from within the local area is giving rise to a vibrant process of learning, and so fueling the modernizing potential demonstrated by the social production of habitat

First of all, it is possible to measure the existing shortages and deficiencies in a different way. If a dwelling is “a place where someone is living,” then there are many more dwellings than those reflected in official figures. We might venture to say that save for a few exceptions, everyone has a dwelling, even if it is no more than a few cardboard boxes in the street or a fragile shack built on a hazardous spot. We ought to recognize that the inhabitants of a city are not polarized into those who have and those who do not have a dwelling, or those who live “properly” and those who are sunk in precarious living conditions. The picture is a more complex one, full of nuances, where shortages need to be tackled with focalized and specific interventions, rather as public health policies confront the different maladies of their objective population. Above all, however, the inhabitants should no longer be regarded as mere receivers of goods and services provided by others. It must be accepted that the city is built shoulder to shoulder with them.

Social Production of Habitat

Popular movements have been accumulating valuable experience in this field for many years, and they could share the strategies and instruments now at their disposal with those urban planning and housing policies which opt to confront the problems of cities from this renewed perspective. In the 1970s, the concept of “social production of habitat” was coined in Latin America to refer to the important contribution of urban communities to city construction. After prolonged periods of exacerbated poverty and interrupted democracy in many countries, and the later introduction of models of housing subsidy based on demand that turned dwellings into goods bought and sold on the market, the social production of habitat all but disappeared from the region. New versions have emerged, however, especially in Asian and African cities, not only demonstrating great vitality but also incorporating novel perspectives and components with which to confront the enormous challenges faced by the city of the twenty-first century.

For example, it is worth singling out the way in which they have confronted the scale of the housing problems that affect a large volume of the poor inhabitants of hundreds of urban centers. These city builders have managed to transform a contingent weakness, the widespread presence of poverty and slums in cities, into a formidable advantage for political interlocution at the urban level by agglutinating themselves into community organizations that now form networks with a regional scope. They have

thus acquired enough political and strategic power to be taken into account by the other players in the urban scenario. Two examples are Slum Dwellers Int (SDI), which groups communities from 478 cities in thirty-three countries, mainly in Africa, and the Asian Coalition for Community Action (ACCA), a regional initiative sustained by organizations from 165 cities in nineteen Asian countries. Under the auspices of powerful federations, they promote a multitude of local initiatives in which each community responds to its particular problems according to the priorities, capabilities and resources of its members. Up to now, large-scale operation has not prevented the responses from being specific to each case, something which unfortunately cannot be said for the uniform and repetitive solutions conventionally adopted for attending to large volumes of housing.

New Strategies

In a context where competition and permanent conflicts between sectors with contrary interests are an intrinsic part of urban life today, the social production of habitat suggests that other paths are there to be explored. To face up to the enormous difficulties that arise when they try to implement their projects in a potentially hostile urban atmosphere, the popular organizations have to act with firmness and determination. Even so, experience has taught them that blind confrontation can have a high cost, and that success is more likely to come with proposals in which everyone has something to gain, or at least in which the costs that have to be paid by others are reduced. Realism has led them to prefer strategies that merge actions to achieve their own objectives with components that could prove attractive to the other players, either in the government or in the private sector. They have also recognized that having financial resources at their disposal gives them the power to take decisions and allows them to negotiate better. Even when resources are generally scarce, they therefore make efforts to save regularly and build up funds that will allow their projects to be supported or cofinanced to a certain degree. They have also assumed the task of documenting their reality in order to have a relatively solid information base and so develop better proposals. It is above all the women and young people of the slums who have acquired the ability to make censuses, profiles and maps of a reality that is largely unknown to the rest of the city, mingling simple door-to-door interview methods with more complex procedures involving the electronic collation and manipulation of data.

These organizations surprise us with a strategic maturity acquired in the course of a development fraught with risks and obstacles to their purposes, a strategy that is not found in other more powerful and “qualified” players within the urban scenario. Their desire is to be not merely beneficiaries but also partners in habitat policies, ready to collaborate with the other players if this will make it easier for them to achieve their aims.

The abyss we have described between the approach to city construction of the inhabitants of popular neighborhoods and that of conventional agents partly explains why specialized training and research centers have not so far generated the knowledge and technology needed by the social builders to perfect their techniques. That is why they have had to resort to their own successes and failures, drawing ideas and practices from them in order to construct and improve their habitat. There is an incessant exchange of experiences in today’s networks, mostly through face-to-face meetings but also, thanks to the technology now available, at a distance. The generation and diffusion of knowledge and skills from within the local area is giving rise to a vibrant process of learning, and so fueling the modernizing potential demonstrated by the social production of habitat in cities of the south.

* * *

In the popular neighborhoods of our cities, an extreme precariousness of habitat affecting numerous communities tends to coexist with the sustained and sometimes heroic efforts of these groups to attenuate the effects of that precariousness and create better living conditions. Habitat policies have until now largely ignored the importance of this effort in the belief that housing and urban problems can only be adequately solved from the outside. However, the limitations of this approach, with its failure to achieve sufficient goals to cope with the general shortage of housing and urban infrastructures, suggest that the social production of habitat might profitably be restored to a central place in urban and housing development strategies. The results achieved by popular builders show that this is an effective path that could gain importance if it were given the recognition and support due to it. It remains to be seen whether housing policies will rise to the challenge and lead a process toward complementary resources and interests that will allow more equitable and sustainable cities to be built. To this end, they should start by recognizing once and for all that if the urban habitat is to be well managed, it is not the construction and real estate firms but the inhabitants who should be their main interlocutors.

Employment and Sustainability

Marek Harsdorff

Former President Barak Obama has said that the defining challenge faced by his successor is achieving economic growth that is equally shared and truly sustainable (Obama 2016). Tackling these two key issues—social justice and environmental sustainability—is not only an immense task but, in addition, one that is often perceived to necessitate a trade-off. This chapter argues that employment and sustainability actually reinforce each other. A job-led green growth strategy delivers more equal results than conventional and capital-led growth. Thus, a strategy that focuses on green employment has the potential to achieve both objectives.

First, this chapter discusses the conceptual link between employment and the environment and the physical interaction between jobs, natural resources, environmental destruction and social justice in particular. Second, the nascent green structural transformation driven by business, consumer and policy shifts is analyzed under the lens of employment and inequality. The chapter ends with some policy conclusions to promote a just transition to environmentally friendly job-rich economies where benefits are more equally shared and growth environmentally sustainable.

Beneficial Physical Interaction between Labor and Nature

“There are no jobs on a dead planet,” read a campaign slogan adopted by the labor movement in the run-up to the historic Climate Change Agreement in 2015, which captured the essence of the link between the environment and employment: Economies and businesses depend on the natural environment to grow, create and sustain jobs. At the same time, unsustainable economic growth destroys the natural environment which, in turn, has negative consequences on economies and jobs. Borrowing a term from biology, symbiosis—defined by the German mycologist Heinrich Anton de Bary as “the living together of unlike organisms”—can help us understand the close and long-term interaction of mutual dependency there is between employment and the environment. The climate’s regulatory function is critical for the food production system on Earth. Agriculture provides employment to 1.3 billion people, which is close to 40 percent of the global workforce and is the world’s largest provider of jobs. But nature not only provides the climate necessary for agriculture, it also provides construction materials, wind, water and solar energy for renewable energy jobs, medicinal plants for health services and cultural value for tourism jobs

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(Millennium Ecosystem Assessment 2005). However, despite providing employment at first, fossil-fuel-based economic growth, environmental destruction, and deforestation are resulting in a changing climate and natural environment, which in turn are having a negative impact on most jobs worldwide (see figure 1).

An important dimension of the link between employment and the environment is that of inequality and poverty. Indeed, it is the poor who disproportionately depend on natural resources for their jobs and income. Studies from Brazil, India and Indonesia indicate that while agriculture, forestry and fishery make up less than 10 percent of the national GDP, for the poor, natural-resource-based activities and income make up more than 75 percent of their GDP (TEEB 2010).

Outsourced Externalities: Worrisome Global Trend

At a global level, two worrying trends can be observed: the deterioration of employment and inequality, and the simultaneous deterioration of the environment. Using the proxy of vulnerable employment and material efficiency for the environment, both indicators show worsening trends.¹

Global material use is a good proxy for environmental sustainability because the more material is used by economic activity the higher the environmental impact in terms of material extraction and pollution stemming from processing, using and discarding materials. Achieving economic growth with less material use—relative decoupling—means economies become more

sustainable. However, from 2000 to 2010 global material use increased from 7.9 tons to 10.1 tons per capita, growing faster than the global GDP. Actually, while at a national level relative decoupling is observed in most economies, globally, material efficiency declined. In 2000, 1.2 kg of materials were required to produce one USD of GDP, rising to 1.4 kg per USD in 2010. The reason for the increase in material intensity at a global level is a shift of global production away from highly material-efficient economies—Europe, the US, Japan and South Korea—to less efficient economies such as China, India, Brazil and South Africa (see table 1).

Coupled with this deteriorating environmental trend, the incidence of vulnerable employment is increasing. In 2000, close to 1.4 billion workers were in vulnerable employment, increasing to around 1.5 billion in 2015 (see table 2).

Vulnerable employment not only limits access to contributory social protection schemes, but is also associated with low productivity and low and volatile earnings. This has led to a global decline of the labor share in national income. Again, one of the reasons is the relocation of production to labor-abundant countries with lower pay and labor standards. This global wage-moderating factor was accompanied by an increase in decent-work deficits in emerging economies (ILO 2015b). Both trends have a social justice dimension. Not only are the poor most impacted by environmental pollution and degradation, but the declining labor shares are associated with more income inequality because capital ownership is more concentrated than labor endowments. Income increased by 20 percent for the top

Figure 1: The link between employment and sustainability

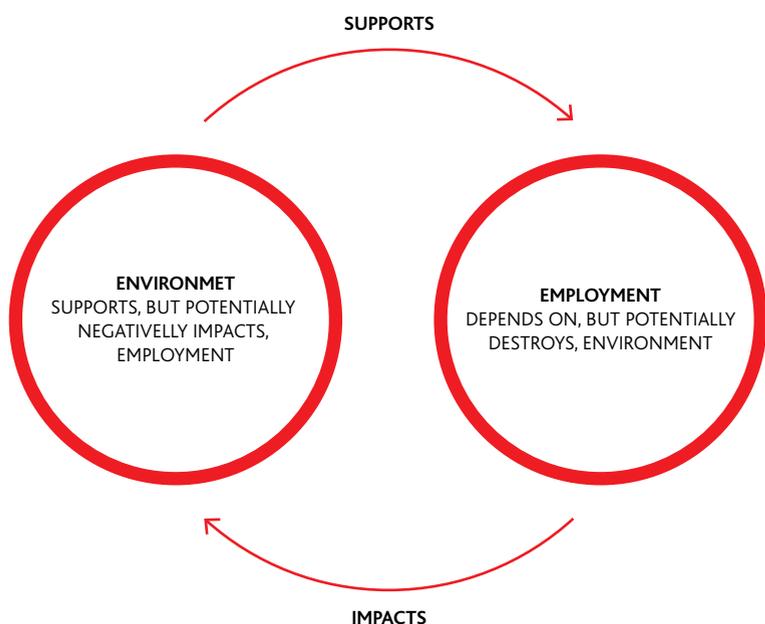
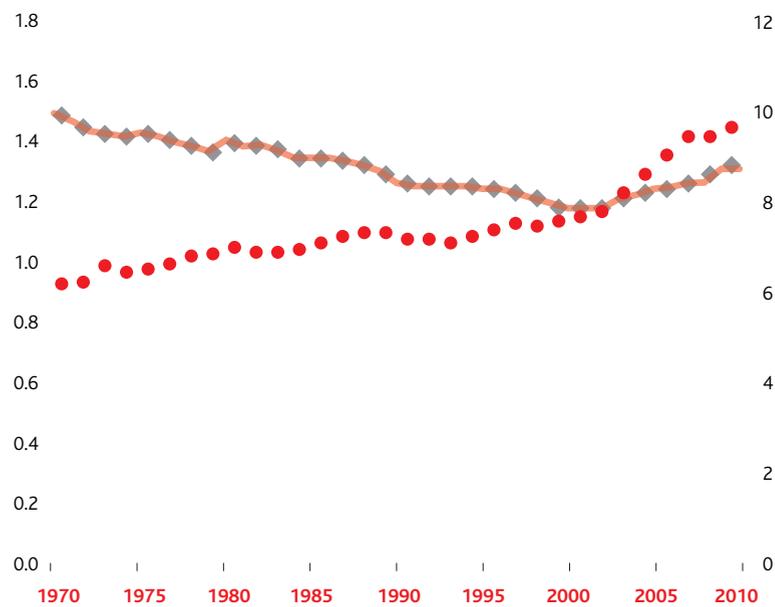


Table 1: Global material intensity in kg per USD 1970-2010



Source: UNEP 2016.

1 percent of income earners, who own most of the capital, over the past twenty years. At the same time, the labor income share for the bottom 99 percent of income earners diminished (OECD 2012) (see table 3).

The redistribution from labor to capital coincides with the externalization of environmental costs. Partly, the reason is the relocation of production to locations with lower environmental and social standards, thereby also putting pressure on locations with higher standards. While there is no proof of causality, the ownership of capital becomes more concentrated (Piketty 2014). At the same time, capital, as a production factor, generally relies on more resource and material use and has, therefore, a higher impact on the environment. Inequality, resource extraction, and pollution often move hand in hand.

Taking the example of China, in 1990 it produced less than 3 percent of global manufacturing output by value. In 2015, due to a shift in global production, close to 25 percent of manufactured goods were produced in China. Its economic rise, which has seen its GDP grow on average 10 percent each year for more than a decade, makes the country's industrialization not unlike those of the industrial revolution of the nineteenth century. However, due to its sheer size, China's environmental and social footprint is far greater than that of any other country in history and has come at the expense of significant social and environmental wellbeing, and public health. The rapid economic growth lifted hundreds of millions of people out of poverty. However, the relocation of millions of workers from rural to urban contexts in relative low-pay and highly polluting industries has made of China one of the most unequal countries in the world. The poorest 25 percent of Chinese households own just 1 percent of the country's total wealth. According to the *Financial Times* (January 14, 2016) China's Gini coefficient for income was 0.49 in 2012, far greater than the US at 0.41. Today, China accounts for 30 percent of global carbon emissions, being the biggest emitter in the world (Oliver et al. 2015). China's Ministry of Environmental Protection estimated the cost of pollution at around USD 227 billion, 3.5 percent of the country's GDP. Life expectancy north of the Huai River is 5.5 years lower than in the south, due to air pollution (Chen et al. 2013).

The environmental and social crisis in China is manifested by a rapid increase in social unrest and protests, known as "mass incidents." The number of such mass incidents has increased from 8,700 in 1993 to more than 120,000 by 2008. While official numbers of mass incidents were not published, cases of various forms of

"violations of social order" rose from 3.2 million in 1995 to 13.9 million in 2012. The Chinese Academy of Social Sciences and China's official trade union federation identify, among others, unemployment, poor labor relations, wage disputes and environmental pollution as the major causes of unrest.²

Global Negative Feedbacks Jeopardize Jobs and Force Migration, Notably of the Poor

The Stern Review (2006) suggests that in a business-as-usual scenario long-term climate change will reduce welfare by an amount equivalent to a reduction in consumption per capita of between 5 percent and 20 percent globally. For example, water availability and crop yields are expected to decline by 20 percent, with a 2°C increase in global temperatures hitting hardest the poorest jobs in non-irrigated agriculture, notably in Africa. Moreover, reductions in labor productivity of up to half of "normal levels" are reported in developing countries with high heat exposure, notably in outdoor work such as construction. Even worse, an estimated 12.6 million people died as a result of living or working in an unhealthy environment in 2012—nearly one in four of total global deaths. This has severe impacts on labor markets and raises the question of social justice, since the poorest are the most affected (Prüss-Üstün et al. 2016).

Disasters induced by climate change have an even more direct impact on jobs. The World Bank estimates the loss of lives and property due to global flood to increase from \$6 billion in 2005 to \$52 billion per year by 2050. According to the 2013 US Geological Survey report on sea-level rise, 1 billion people live and work in low-lying flood-prone areas directly affected by the phenomenon (Taketawa et al. 2013). In 2014, Typhoon Hagupit hit the Philippines, affecting 800,000 workers. The 2011 drought in East Africa affected 13 million people, most of them farmers and pastoralists. In 2008, 20 million persons were displaced globally by extreme weather events, compared to 4.6 million displaced by conflict and violence. Future forecasts predict between 25 million and 1 billion environmental migrants by 2050, the single most important cause for migration. This large amount of migrant workers will put a strain on labor markets everywhere (IOM 2015).

While climate change is probably the biggest environmental threat, the loss of biodiversity and degradation of ecosystems will also have serious implications for jobs and inequality. Some 58.3 million

people, a large proportion of them small-scale and poor fishers, were engaged in the capture of fisheries and aquaculture in 2012. With more than 50 percent of today's capture fish being overexploited, the trends indicate that global fisheries may collapse by 2050—and with it employment (FAO 2014).

A Green Structural Transformation Is Underway, Yielding Environmental Benefits and Creating Decent Jobs

As a response to the present environmental and social risks of unsustainable economic growth, changes in policy, business models, and the behavior of investors and consumers have led to the first signs of a structural transformation towards greener economies.

The Paris Agreement on Climate Change committed 195 countries to keep global average temperature rise below 2°C, while adapting to the changes. To achieve the target, renewable energies need to grow to 80 percent of the total energy mix by 2050, with a near total phasing out of fossil fuels by 2100. The Sustainable Development Goals call for a socially and environmentally integrated sustainable development path. At the national level, China's thirteenth Five-Year Plan for 2016-2020 seeks to achieve 18 percent less carbon intensity by 2020 compared to levels recorded in 2015. This is in line with many countries' realization: decoupling growth from pollution is possible with positive employment and thereby social equality effects.

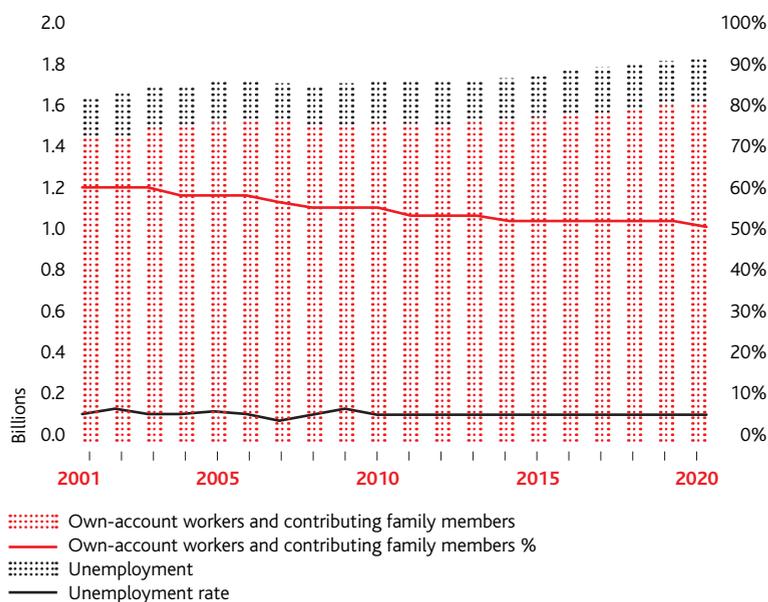
Investments in renewable energies reached USD 285 billion in 2015, surpassing investments in oil, gas and coal

for the first time (REN21 2016). Energy efficiency investments, the so-called hidden fuel, were even higher, amounting to USD 300 billion (IEA 2013). It is estimated that 8.1 million people were employed worldwide in the renewable energy sector, with an even higher number engaged in energy efficiency jobs (IRENA 2016). In the United States alone, it is estimated that by 2050 a net 1.3 to 1.9 million jobs will be created in energy efficiency industries (ACEEE 2015). Jobs in the renewable energy and energy efficiency sectors largely outpace the 9.8 million jobs still linked to fossil fuels, notably coal (Teske, Sawyer and Schäfer 2015). The rapidly falling costs in renewables drove growth in the industry, while high extraction cost, notably for coal, led to decreasing investment and jobs in that sector. The gap is set to grow further, with jobs in solar and wind energy sources growing over 20 percent, while oil and gas jobs fell by 18 percent as the fossil fuel industry struggled with low prices. China employs 3.5 million people in the renewable sector, whereas just 2.6 million are employed in oil and gas activities. Doubling the global share of renewable energy by 2030 could lead to 24 million net new jobs (IRENA 2016).

While investment in renewables is rapidly growing, in 2015 the Norwegian parliament confirmed a major coal divestment by its USD 900 billion sovereign wealth fund, the largest fossil fuel divestment to date, which affects 122 companies across the world. Investors are beginning to realize that fossil fuel investments might become stranded assets.

The reason for the positive labor market outcomes of renewable energies lies mainly in the fact that on average

Table 2: Global vulnerable employment



Source: ILO Global Trends 2015.

Table 3: Labor shares in national income of selected G20 countries



Source: ILO, based on main national accounts from UNdata (www.data.un.org) for selected group of countries.

Unsustainable economic growth destroys the natural environment which, in turn, has negative consequences on economies and jobs

fossil-fuel-based industries are more capital-intensive than renewable industries. Construction, operation and maintenance of renewable technology creates more direct jobs per unit of energy generated. In addition, renewable energy, harvested locally, has longer value chains which require more indirect jobs in supplying industries. Decentralized systems create an even higher number of jobs in operation and maintenance, as those have to be locally serviced (see table 4).

For example, a recent study in the United States considered the economy-wide effects of reducing emissions by 40 percent by 2030 through a mix of clean energy and energy efficiency. The assumption is that a USD 200 billion investment per year would be necessary for achieving the target, which would result in a net gain of about 4 million jobs. The net effect takes into consideration the loss of 1.5 million jobs in fossil- and energy-intensive sectors as well as the creation of 4.2 million jobs in environmental goods and service sectors and their supply chains. In addition, the study assumes that savings derived from energy efficiency and lower energy costs would be reinvested, creating an additional 1.2 to 1.8 million jobs. The net gains of about 4 million jobs would reduce the unemployment rate by 1.5 percentage points, thereby reducing inequality (Pollin et al. 2014).

Increased Material Efficiency: A Future Source of Productivity Growth in a Circular Economy

Businesses have come to realize that gains can be made not only in clean energy technology but in the space of a circular production system which yields a less resource-intensive economy. Global companies are adopting circular production systems, moving away from produce-use-discard dynamics in favor of produce-use-reuse ones and circular service systems. Moving from linear economies, which are manufacturing-driven, towards circular systems, which are service-driven, will create net new jobs due to the simple fact that service is more labor-intensive than manufacturing. McKinsey estimates that a circular-economy scenario would result in a 7 percent increase in Europe's GDP by 2030, as opposed to a business-as-usual scenario. The scenario adopts available technology for a circular production system in food, mobility and housing (Ellen MacArthur Foundation and McKinsey 2015). Additionally, employment effects are estimated to be positive. In Europe, every percentage point reduction in resource use is estimated to lead to 100,000–200,000 new jobs (Council of the European

Union 2014). Today, material efficiency, which as shown above has been sluggish and even reversing in the last years, is seen as an untapped source of future productivity growth—unlike the trend of the past fifty years, whereby the main source of labor productivity has been the replacement of labor with capital (see table 5).

An energy and material-efficiency scenario was built for five European countries reducing emissions by more than 75 percent. In such a circular-economy scenario the number of additional net jobs are estimated at 1.3 million (Wijkman and Skånberg 2016). Increasing the recycling rate of key materials in the European Union to 70 percent could create an additional 560,000 new jobs by 2025, notably in reach of poorer households (Friends of the Earth 2010). Further to manufacturing and service jobs, green economy creates employment, notably for the less skilled, in conserving biodiversity and managing and restoring the natural environment, which in Europe stands at 14.6 million jobs (Nunes et al. 2011).

The Right Policy Mix

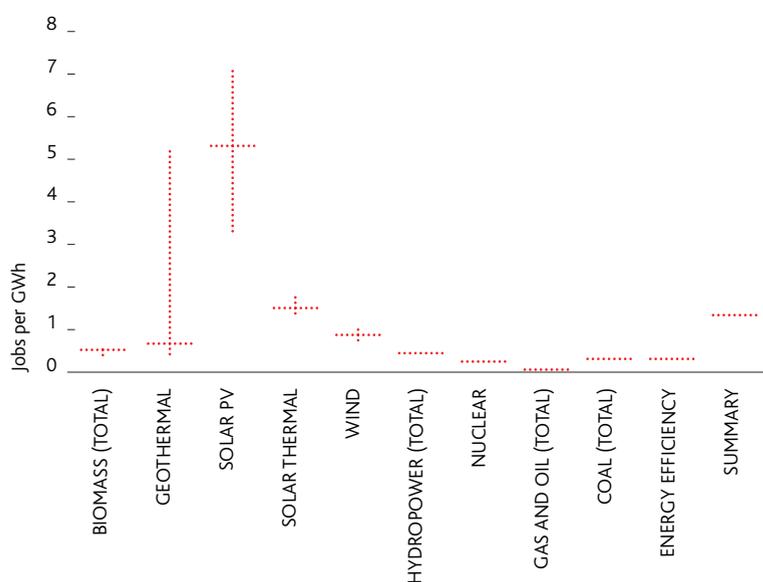
A win-win-win scenario for the environment, jobs and the economy will not happen by default. It requires the right mix of employment-led green policies as a lever to climate-resilient economic growth. The overall positive effect of greener economies on employment and equality is not unfolding by default, and must be analyzed in the context of declining industries, regional and global production and consumption shifts, changing business models, material and labor productivity, and

technological innovation. Working conditions will change: new jobs will be created, others will transform, and some will disappear, whilst income and capital distribution and equality will be altered. Resource-dependent countries and extractive industries face downsizing, while jobs and industries in climatically vulnerable countries continue to be affected. More than one million jobs have been lost in coal mining in China over the last few years, while millions of jobs were affected and destroyed by the impacts of climate change in developing countries. This calls for social justice and a just transition as per the mandate of the International Labour Organization (ILO). Member states of the ILO adopted the Just Transition Guidelines to buffer the social consequences of climate change and promote decent work in a green economic restructuring (ILO 2008 and 2015a). To achieve job-led economic growth which is equally shared and is truly sustainable three key issues must be addressed:

Green Macro-Economic Fiscal Policy Reform

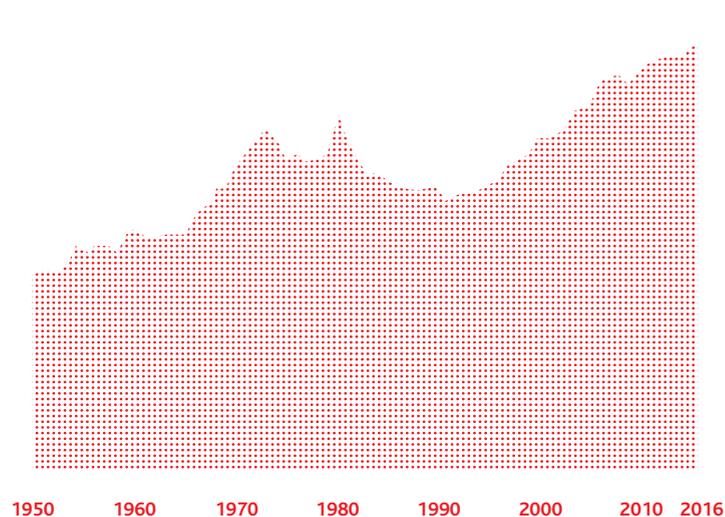
Key to the future is the implementation of an environmentally friendly labor tax reform, such as a fiscal-neutral eco-tax that shifts the burden from labor to pollution and the use of resources. The ILO's Global Economic Linkages (GEL) model indicates that if an eco-tax is combined with measures in support of employment multi-factor productivity would be 5 percent higher by 2050 than if green taxes are not used to support employment. The OECD's Environmental Linkages model indicates that if revenues from an eco-tax are used to lower labor taxes, employment gains of nearly 2 percent are possible by 2030, as compared to a

Table 4: Average number of Jobs per GWh in Construction, Operation and Maintenance in renewable and conventional energy production systems



Source: ILO 2012 Meta Study Employment and Renewable Energy.

Table 5: Global labor productivity per person employed in 2015 US\$



Source: Author's calculation based on data from The Conference Board Total Economy Database, May 2016, <http://www.conference-board.org/data/economydatabase/> (converted to 2015 price level with updated 2011 PPPs).

business-as-usual scenario (OECD 2011). At a global level, if a tax on CO₂ emissions were imposed and the resulting revenues were used to cut labor taxes, then up to 14 million net new jobs could be created (ILO 2009). Tools and models for macro-economic employment assessments and projections are key for policy planning to guide economic diversification, climate resilience and structural change.

Investing into Equal Opportunities, Human Capital and Enterprises for Greener Economies

Putting in place social and labor market policies is essential to enable a transition to climate-resilient and greener economies which are also socially inclusive for women and men. Investing in skills, education, enterprise development and entrepreneurship to facilitate the transition and improve employability is critical because without skilled workers and competent enterprises the shift to a climate-resilient and greener economy will be neither technically feasible nor economically viable. The ILO's *Skills for Green Jobs* report highlights the existing skills gap, and indicates that the main holding-back factor is the shortage of green human capital (ILO 2011). Social protection schemes are central and need to be linked to job-search assistance and matching through employment services. Making social protection work alleviates social, economic and environmental crises, while enabling structural change towards climate-resilient and greener economies.

Place Social Dialogue at the Center of Policy Making

Effective dialogue can help resolve crucial socio-economic and environmental issues and improve economic performance. Given that the transition towards a greener and climate-resilient economy will entail profound changes in production processes and technologies, as well as the reallocation of jobs, close cooperation between governments and social partners is central to the success of this transformation. The program of renovation of buildings for energy efficiency in Germany has mobilized about €100 billion over the past decade, making it the largest such program worldwide. It was originally proposed to the government by the German trade unions and employers' organization as a "pact for the environment and employment," creating and sustaining more than 300,000 jobs per year since its inception (BMVBS 2012). Effective social dialogue is necessary to ensure that policies are coherent and that change is adopted and long-lasting (ILO 2012).

Notes

1. Vulnerable employment refers to own-account work and contributing family employment. Material efficiency is the total use of material necessary to produce one unit of output and includes fossil fuels as well as renewable resources.

2. *Stability in China: Lessons Learned from Tiananmen and Implications for the United States, Hearing Before the U.S.-China Economic and Security Review Commission*, 113th Cong. (May 15, 2014) (Testimony of Murray Scot Tanner, Senior Research Scientist China Studies Division CNA).

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Food and Development

Paolo Bifani

Goal Two of the 2030 Agenda for Sustainable Development adopted by the United Nations is to end hunger, to achieve food security and improved nutrition by promoting sustainable agriculture. The challenge arises not only from the need to overcome current deficiencies but also from the fact that by 2030 the world's population will have increased by 14 percent to 8.5 billion people, which amounts to a hike of 1.1 billion inhabitants.

Science magazine pointed out that one of the greatest scientific and technological achievements of the last century was that food production rates since the end of the Second World War have always been kept higher than the rate of expansion of the population. Much of this achievement was due to increases in productivity per area cultivated and per worker employed. Until the Second World War, productivity had increased owing to mechanization and the expansion of farmed areas. Once the cycle of conventional technological innovations had matured and it was impossible for agricultural land to expand further, increased productivity now became a matter of biological innovation. The hybridization that began to be used in the mid 1930s became generalized between 1945 and 1960 with the green revolution, which spread hybrids of maize, wheat and rice developed at the CGIAR centers (CIMMYT and IRRI). The green revolution has also had negative effects, such as the concentration of agricultural property and the increasing concentration of culture in few varieties, with loss of diversity, greater vulnerability to plagues and diseases, and an increase in the use of agrochemicals.

Like every technological innovation, the green revolution reached maturity and the rates of increase in productivity thereafter gradually started to decline, falling from 3.2 percent in 1960 to 1.5 percent in 2000.

Since the late 1980s, increased agricultural production and productivity has been boosted by molecular biology and genetic engineering. These scientific advances have spawned controversy owing to the spread of transgenic varieties. New scientific and technological prospects for food production have been opened up by synthetic molecular biology since 2000, and by genomic editing, CRISPR-Cas9, from 2011–2012.

More than fifty thousand edible plants are known, but only fifteen of them provide 90 percent of all food consumed. Three cereals—rice, wheat and maize—account for more than two thirds of that consumption, representing 42.5 percent of total calories and more than

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94 percent of the total consumption of cereals. The world production of rice more than tripled between 1961 and 2010, with an average annual growth of 2.24 percent made up of a 1.74 percent increase in yield (51.1 kg/ha per annum in absolute terms) and a 0.49 percent expansion of cultivated area. By the mid 1990s, however, increases in productivity were lower than the rate of population growth, leading to imbalances between supply and demand and to rising prices, which increased between 2001 and 2007, for example, by 67 percent. There were various causes for this: the potential of high-yield varieties has been almost totally exploited, rice fields were moved to land of poorer quality to make room for more economically profitable crops, and agrochemical input became more costly while resistance to it grew.

High-yield cultivars with resistance to disease have allowed wheat production to grow. Average yields were 1 ton/ha in 1951 and 2.5 ton/ha in 1995. In the same period, the yield in India went from 1 ton/ha to 2.1 ton/ha, and in China from 1.4 ton/ha to 4.6 ton/ha. The average worldwide yield is currently 3.3 ton/ha, with the highest figure, 9.1 ton/ha, in New Zealand, which has maximum yields of up to 15 ton/ha.

In 2013, 1,016 million tons of maize were produced. Up to 68 percent of the area sown with this crop is in developing countries, yet these contribute only 46 percent of world production, a reflection of a considerable gap between the respective productivities of developed countries (8 ton/ha) and developing countries (less than 3 ton/ha). The particular agroecological and social characteristics of maize explain this divergence. More than 90 percent of the area sown with maize in developed countries lies in temperate zones, while this is true of only 25 percent of the area in developing countries (Argentina and China). Maize is very sensitive to the natural limiting factors typical of tropical zones. Moreover, less than 50 percent of the maize-growing area in developing countries is cultivated with high-yield varieties (HYV). In developing countries, those who grow maize are small landowners who are unable to access HYV, which partly explains their low productivity. Reducing this gap requires effective mechanisms for the diffusion of technological change and the integration of poor and subsistence-level rural communities in the market.

Average world productivity of wheat and rice is close to the technological frontier, and so tending to stabilize. This is not the case with maize. Maize is a crop with two major peculiarities. The first is that it is an open-pollinated plant, meaning that the genetic material for its reproduction comes from exchange with neighboring

plants. Rice and wheat are self-pollinated, meaning they are fertilized by pollen from the plant itself. When maize is self-pollinated, the resulting progeny yields less and its fruits are of lower quality. Open pollination allows a natural process of hybridization that gives the plant heterosis, or hybrid vigor, generating a more vigorous and uniform progeny with higher yield. The poor communities already know this. In Chiapas, therefore, as many as six different varieties of maize were grown in a single *milpa*, or agricultural plot. R&D is searching for more efficient cultivars of higher quality, resistance and tolerance through carefully controlled cross-fertilization.

Hybrids of greater productivity for tropical and subtropical regions, developed at CIMMYT, range from 5 ton/ha to 8–10 ton/ha respectively. Unfortunately, these varieties are beyond the reach of poor rural communities.

In tropical and subtropical zones, maize has to contend with abiotic and biotic obstacles such as drought, acidic and infertile soil, plagues, diseases and insects. R&D is aiming to reduce the vulnerability of maize to drought, which has historically caused losses of between 15 and 60 percent, by exploring such possibilities as the creation of early maturing germplasm, which would enable the maize to avoid drought. These varieties are available in Mexico, Kenya and Colombia. Regrettably, their yield is relatively low. Another alternative is to identify the genes responsible for tolerance to drought in sorghum, which is a C4 plant that shares many properties with maize, and activate them in maize germplasm.

The second peculiarity of maize is that it is a C4 plant, meaning it has four carbon molecules. This makes for very efficient photosynthesis, with a synthesization of carbon dioxide and water that stores solar energy in carbohydrate molecules. Rice and wheat are C3 plants, with only three carbon molecules and relatively inefficient photosynthesis, and they moreover expend up to 25 percent of their energy on phototranspiration. The peculiar anatomy of the leaves of C4 plants prevents phototranspiration, so the energy that would have been spent on it goes instead to the formation of carbohydrates, resulting in an efficient conversion of solar energy. If rice were a C4, its productivity would increase by more than 50 percent. This is the objective of the IRRI's Rice C4 project, which receives a contribution of US\$14 million from the Bill and Melinda Gates Foundation.

Intercropping and integrated agricultural systems are sustainable, increase the range of food available and improve its quality. Intercropping of maize with beans, pumpkin (common in *milpas*), soya, peas and chickpeas,

all practiced since antiquity in poor and subsistence-level communities, increase the maize yield by 25 percent. Legumes fix nitrogen, and when sown with wheat satisfy from 20 to 40 percent of its nitrogen requirement, resulting in a higher yield and protein content.

Integrated systems of rice cultivation and fish breeding are sustainable and contribute to an improved diet owing to a greater supply of animal protein, and to an increase in family income in rural communities. They improve the fertility of the soil by contributing nitrogen and potassium, and they reduce plagues and diseases because the fish eat insects, larvae, snails, algae and weeds where mosquitoes and other insects nest. They also aid the aeration of the water and the control of aquatic weeds. This agricultural practice, first promoted as a component of integrated plague control systems, results in an 8 to 15 percent increase in the rice yield. In Bangladesh, 40 percent of the fish is consumed by the producer and the rest is sold, generating an additional source of income.

Losses after harvesting and during consumption are calculated at 1.3 thousand million tons per year, equivalent to between 30 and 50 percent of total food production. The greatest losses, 95 to 115 kg per person per annum, occur during consumption in the developed countries, and are inherent to a wasteful lifestyle. In sub-Saharan Africa and South-East Asia, the figure ranges from 6 to 11 kg per person per annum. In developing countries, the losses occur during post-harvest operations, storage, transportation and distribution, and are the result of a lack of product management practices and technologies in the value chain. Food loss also brings external diseconomies. For example, it originates from 6 to 10 percent of anthropic emissions of greenhouse gases, basically methane.

Among the goals for development is that of improving nutritional quality. The undernourished population now numbers 868 million people, and 2,000 million suffer from some form of micronutrient deficiency. As much as 26 percent of children under five suffer from retarded growth, and 31 percent from vitamin A deficiency.

Improved food is generally a function of an increase in the population's income and purchasing power. As the income per capita increases, the consumption of vegetable protein is replaced by that of animal protein. From 1960 to 2010, the consumption per capita of milk in developing countries doubled, that of meat more than tripled, and that of eggs quintupled. This was made possible by the expansion of livestock production in most countries, especially China and Brazil, and the growing

use of cereals as forage, which absorbs 33 to 35 percent of the world cereal production.

The new varieties also help to improve nutritional quality. Those of the green revolution met greater nutritional demands as well as offering higher yields. The bio-fortification achieved through hybridization enriches nutritional plant contents with micronutrients. Among the varieties being disseminated by the CGIAR is a variety of sweet potato, the Orange Fleshed Sweet Potato (OFSP), which is rich in vitamin A thanks to the insertion of two genes obtained from daffodil and the bacteria *Erwinia uredovora* that synthesize beta-carotene in the edible part of the plant. It is resistant to disease and tolerant to drought and acidic soil. Similar varieties exist for cassava and maize, and varieties with high iron content have been made widely available for beans, rice, wheat and millet. The Opaque2 variety of the CIMMYT's Quality Protein Maize (QPM) contains twice as much protein as normal maize, but it unfortunately suffers from relatively low productivity and it is vulnerable to disease and to losses during storage. The greatest expectations are focused on *golden rice*, a variety of rice rich in vitamin A thanks to the biosynthesis of beta-carotene in the edible part of the plant. This IRRI project is financially supported by the Helen Keller and Bill and Melinda Gates Foundations.

Food production can increase, diversify and improve with the incorporation of species that have fallen into disuse. Nearly 150 plants are used for food in India, and 200 in Ghana. The consumption of amaranth, which was extinguished by the Spanish, is now making a comeback, as is that of quinoa, oca and teff. These products are appreciated in developed countries because they are gluten free with high protein content. Amaranth is also being studied for its resistance to round-up and glyphosate.

The achievement of Goal Two of the United Nations does not depend only on scientific and technological alternatives, on an enlarged range of utilizable resources, or on changes in consumption patterns. The materialization of these possibilities is subject also to sociopolitical and economic structures.

Scientific and technological advances have been associated with profound transformations in the underlying institutionality of the economic, scientific and technological structure. Until the molecular biology and genetic engineering revolution, agricultural R&D and its diffusion were the responsibility of public institutions, universities, or government R&D centers. The

characteristics of biotechnological innovations permit their appropriation, which has a decisive influence on changes in intellectual property systems and their internationalization. At the same time, they have led to a revaluation of the genetic material or germplasm present in nature, giving rise to a process of commoditization and private appropriation of genetic resources through patents or plant breeders' rights (PBR). The traffic in germplasm and its transformation into goods for private gain has historically been characterized by free and unlimited appropriation. Biopiracy perpetuates this perverse appropriation of the germplasm for centuries. The large number of current applications for biotechnological patents, together with the use of cross-licensing, has allowed intellectual property rights to accumulate in a small group of transnationals, while acquisitions and mergers lead to the concentration of chemical, pharmaceutical, food and agriculture, biotechnology and seed companies in a powerful genome-based oligopoly.

Success in achieving Goal Two of the United Nations is conditioned by the socioeconomic situation, economic growth, the defeat of poverty and a more equitable distribution of income. The population in extreme poverty was reduced by 50 percent between 1999 and 2011, but despite this one in every five people in the developing world still lives beneath the poverty line of US\$1.90 per day. The relations between economic growth, poverty and inequality are extremely complex. There is a negative correlation between growth of income per capita and poverty: growth of income per capita only reduces poverty if it does not increase inequality. The reduction of inequality is generally associated with the reduction of poverty. In its turn, the rate of reduction of poverty depends on the existing level of development and equality. Greater equality accelerates the reduction of poverty. Studies on income elasticity of poverty show that an average increase of 1 percent in GDP per capita ought to reduce poverty per capita by 1.5 percent. Economic growth, no matter how rapid, is not enough in itself to reduce poverty. Not only must it avoid creating inequality, but it must also be accompanied by policies that reduce inequality and redistribute income. The sectorial structure of production affects equality, the redistribution of income, and consequently poverty. The expansion of labor-intensive activities has been an important factor in the reduction of poverty in the countries of Southeast Asia, particularly when accompanied by absorption of technology, increased productivity, and wage rises in accordance with productivity increases. For example, Vietnam, with a Gini coefficient of 0.30 and 50 percent of

its activity in labor-intensive sectors, and with heavy investment in education, health and infrastructure and a solid social safety net, displays impressive achievements in the reduction of poverty, malnutrition and hunger. On the other hand, countries rich in natural resources, with economic activities predominantly in the highly capital-intensive energy or mining sectors, tend to have a much weaker relationship between growth of GDP per capita and reduction of poverty, particularly if those sectors materialize as enclaves with scant technological spillover toward the rest of the economy.

Ultimately, the accomplishment of Goal Two of the United Nations is dependent upon the achievements of others. In the meantime, it will also be conditioned by the effects of climate change on food production. An analysis of this falls outside the scope of these brief reflections.

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Horizons

Sze Tsung Nicolás Leong

In the words of Sze Tsung Nicolás Leong (Mexico, 1970), the horizon in its most basic form is not only the line where sky and earth meet, it is also the most distant point reached by the gaze, and the limit of what we know. It separates and at the same time connects “acquaintances and strangers, relatives and foreigners, the near and the far.” Born of these reflections, *Horizons* is a series of photographs that form part of a continuous landscape running from the *ghats* of Varanasi and the steel and glass skyline of Seoul to the urban sprawl of Amman and the Andean peaks of Quito. It is the landscape of a planet that “floats in a space with no known limits.”



Dubai I, 2007





Han-Gang, Seoul, 2008





Ganga (Ganges) I, Varanasi, 2008



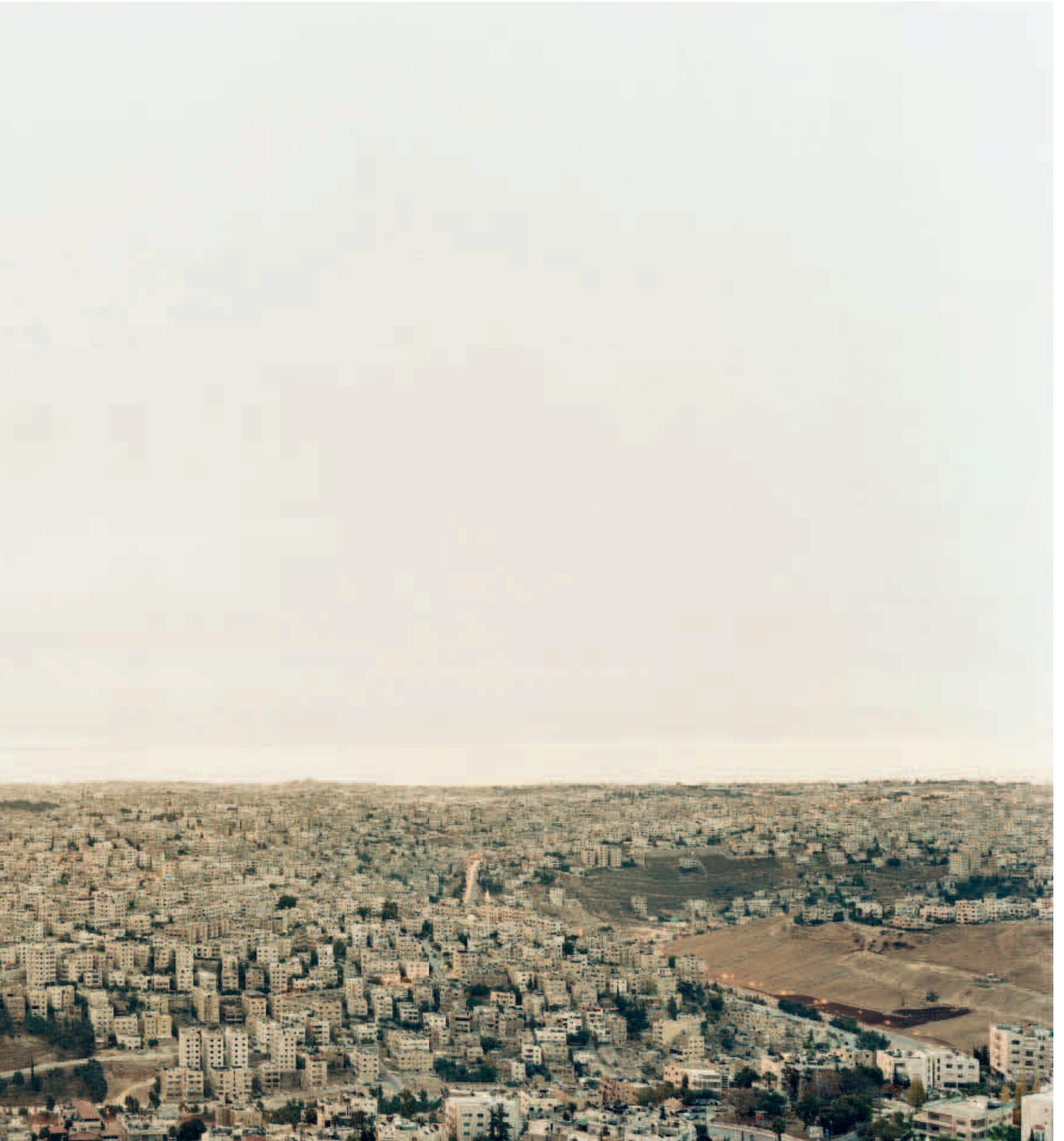


Lake Michigan, 2012





Amman, 2007





Mexico City, 2009





Quito, 2010





Old Havana II, 2010



2. *Hardware versus Software and Mindware*

Urban planning
which creates more
compact, mixed and
walkable neighborhoods
enhance our security
and spirit

Todd Litman

The provision of housing
for the increased
population in 2050 will
demand of the construction
sector all the greenhouse
gas emissions that will be
admissible that year

Albert Cuchi

Mobility and Innovation. The New Transportation Paradigm

Todd Litman

Todd Litman is the founder and executive director of the Victoria Transport Policy Institute, an independent research organization in Canada dedicated to developing innovative solutions to transport problems.

Where is our flying car? When can I fly by supersonic jet? Where is my jetpack?

If you look at predictions made a few decades ago, the twenty-first century transportation system was supposed to include flying cars that eliminate traffic congestion, supersonic airline travel to exotic destinations, and jetpacks eliminating the need to walk.

The reality is more modest. We live in a period of great innovation, but most twenty-first century transport improvements do not make travel faster (maximum commercial aviation speeds declined after the Concorde supersonic jet service was grounded in 2003) or replace non-motorized with motorized travel (many cities are improving walking and cycling conditions, resulting in more use of these modes). Recent innovations that improve everyday urban transport include wheeled luggage, electronic navigation systems, and bike lanes: innovations that increase travel convenience and comfort, not speed.

These are important but often underrated innovations. The human experience is increasingly urban. Cities are, by definition, places where many people and activities locate close together. This proximity facilitates positive interactions, both planned (accessing shops, services, jobs and entertainment) and unplanned (encountering old friends while walking on the street or riding in a bus, or seeing interesting products in a store window). As a result, urban living tends to increase our productivity and creativity, a phenomenon known as economies of agglomeration. Scientific studies find that, all else being equal, people's economic success and ability to innovate tend to increase with the size and urban density of the cities in which they live.

However, proximity can also create problems, including traffic and parking congestion, high costs for infrastructure such as roads and parking facilities, plus noise and air pollution. These impacts can spoil the benefits of cities, making them inefficient and unpleasant. But these problems are not inevitable, they are caused by motor vehicles, not people, and so can be solved by taming excessive automobile travel.

Automobiles are resource-intensive, they require far more space than other urban travel modes. Because they are large and fast, automobile travel requires far more road space per passenger-kilometer, and each vehicle requires several parking spaces at destinations (home, work, shops, and so on). As a result, to be convenient and safe, each urban automobile requires 100 to 400 square

meters of land for roads and parking facilities, more than ten times as much as the space required to travel by foot, bike or public transit, and two or three times as much land as a typical urban resident needs for housing and workspace. Consequently, the number of people who can comfortably live in an urban area declines rapidly as vehicle ownership increases.

Automobile travel imposes other costs. Owning and operating a car costs thousands of dollars annually, which is unaffordable for many households. Automobile accidents are a major cause of injury and death, and motor vehicles are the primary source of noise and air pollution in most cities. Automobile travel imposes congestion delays on other vehicles, and wider roads and increased vehicle traffic creates the so-called barrier effect, degrading conditions for active modes of transport (walking and cycling). This reduces mobility for non-drivers, and by discouraging walking and cycling, hampers public fitness and health.

An efficient and equitable transportation system must be diverse in order to serve different users and purposes. This allows each mode to be used for what it does best: convenient walking and cycling for local errands, efficient public transit for passenger transport on major urban corridors, and automobile travel when it is truly optimal. Most communities include people who cannot or should not drive due to disability, low incomes or age, and even those who *could* drive often prefer transit travel

if it allows them to relax or work en route, and active modes for the sake of health and enjoyment.

This is not to suggest that motor vehicles are “bad” and should be forbidden, but automobile travel is far more costly than most people realize, considering all impacts. Therefore, an effective city limits automobile travel regulation must be mindful both of what the road system and parking facilities can efficiently accommodate, and of what is needed to protect walking, cycling and public transit conditions. My research indicates that, considering all benefits and costs, socially optimal vehicle ownership rates range from 100 automobiles per one thousand residents in central city neighborhoods up to 350 vehicles per one thousand residents in lower-density urban-fringe areas. Similarly, optimal automobile mode share (the portion of trips made by that mode) range from 10 percent in central areas up to 35 percent at the urban fringe; beyond these levels transport system performance declines, making everybody worse off. Achieving these targets requires a conservation ethic—that is, an emphasis on efficient resource consumption, using transportation demand management (TDM) strategies to encourage travelers to use the best option for each trip.

Conventional urban transportation planning assumes that our goal is to maximize mobility (physical movement), and so assumes that automobile travel is better than slower modes. This justifies planning decisions that favor automobile travel, often to the

Figure 1: Space required to commute by various modes

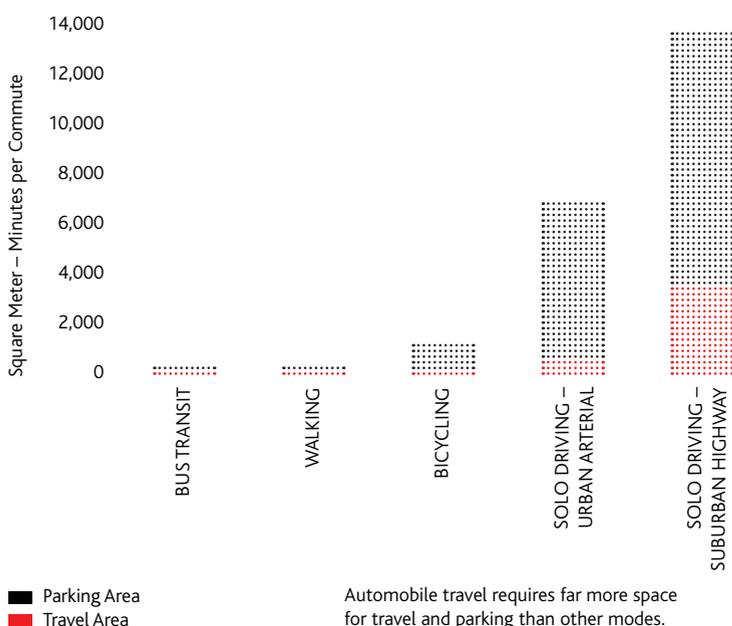
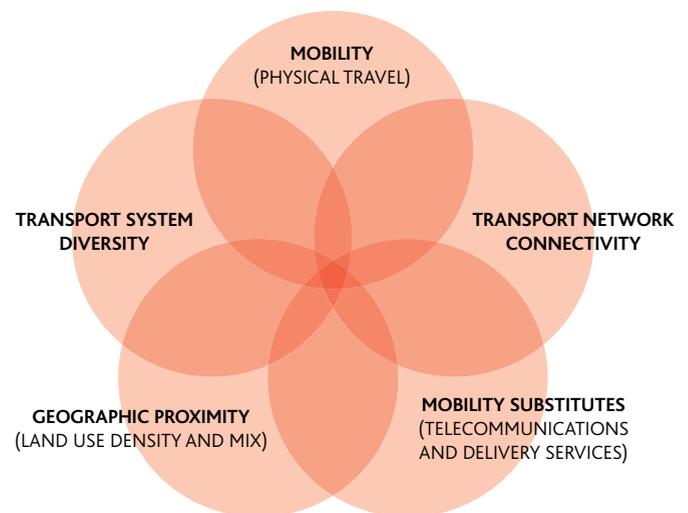


Figure 2: Factors affecting accessibility



Various factors affect accessibility, including mobility, transport system diversity, transport network connectivity, geographic proximity, and mobility substitutes such as telecommunications and delivery services. The new transport planning paradigm considers all of these factors.

Socially optimal vehicle ownership rates range from 100 automobiles per one thousand residents in central city neighborhoods up to 350 vehicles per one thousand residents in lower-density urban-fringe areas

detriment of other modes, for example, roadway widening that degrades walking and cycling conditions, parking requirements that stimulate sprawl, and inadequate investment of road space and money into public transit, resulting in poor quality service.

A new urban-planning paradigm is more comprehensive and integrated. It emphasizes that mobility is seldom an end in itself: the ultimate goal of most travel activity is access to desired services and activities. Several factors affect accessibility, including mobility (travel speed and distance), transport system diversity (the quality of travel options available), transport network connectivity, geographic proximity (land-use density and mix, and therefore the distances people must travel to reach services and activities), and mobility substitutes (telecommunications and delivery services), as illustrated below.

Conventional planning, which results in wide roads and large parking facility requirements, contributes to a self-reinforcing cycle that results in automobile dependency and sprawl, as illustrated in figure 3. The new paradigm recognizes that “smart growth” policies which create more compact, connected and multi-modal communities tend to increase overall accessibility. This results in “urban villages,” which are neighborhoods that contain the combination of services and facilities most often used by residents—restaurants and cafés, well-stocked grocery stores, pharmacies, barbers and hair dressers, banks, schools, parks, gyms, doctors and dentists—within walking distance of most homes. Even if vehicle traffic speeds are lower, the distances that must be traveled to reach destinations are also shorter. Residents of such communities tend to own fewer cars, drive less, rely more on active and public transport modes, spend less on transport, be safer and healthier, and require less spending on roads and parking than they would if they lived in more automobile-dependent areas.

One of the most important and effective ways of improving accessibility is to ensure that any household, including those with low income, can find suitable housing in central, walkable neighborhoods. Cheap housing is not truly affordable if located in inaccessible areas where residents must devote excessive amounts of time and money to reach common destinations. This means that public housing cannot be confined to peripheral zones, and that government policies should encourage private developers to build lower-priced housing in accessible areas.

Some technological innovations can improve urban transportation, including better user information, more convenient payment systems, and better ways to share vehicles and parking facilities. More efficient and alternative fuels can reduce environmental impacts, and self-driving cars may someday improve mobility options for non-drivers, although by making driving cheaper and easier they might also increase total vehicle traffic and associated problems. As a result, such technologies may degrade urban transport conditions overall, unless they are implemented with appropriate incentives, such as more efficient pricing.

We have a rich vocabulary to describe overpricing—we say that we are gouged, gypped and cheated—but underpricing is equally harmful. When roads, parking facilities, and fuel are too cheap, we overuse them, resulting in congestion, accidents and pollution problems. Motorists generally prefer “free” rather than pay roads and parking, but these are never really free: the choice is between financing them directly, through tolls and user fees, or indirectly through general taxes (to pay for roads) and rents (to pay for free off-street parking facilities). Paying directly is preferable because it can ration the use of these scarce resources, avoiding traffic and parking congestion, and it prevents people who drive less than average from subsidizing facilities for people who drive more than average.

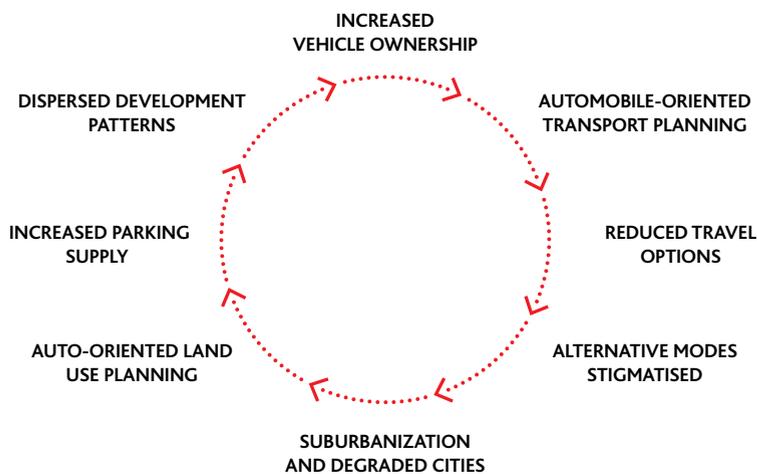
The new planning paradigm recognizes the unique and important roles that walking, cycling and public transit

play in an efficient and equitable transportation system, and so applies a sustainable transportation hierarchy which ensures that, when resources (road space, land and money) are constrained, policies favor resource-efficient over resource-intensive modes. This is the key to creating sustainable transportation systems.

The new urban-planning paradigm considers a wider range of planning objectives and transportation-improvement options. This helps identify truly optional transport improvements, sometimes called win-win solutions, such as congestion reduction strategies that also reduce parking problems, increase affordability, improve mobility options for non-drivers, and increase public fitness and health. For example, expanding roadways may reduce traffic congestion, at least in the short run, and more efficient and alternative fuel vehicles help conserve energy and reduce pollution emissions, but provide no other benefits. In contrast, improving resource-efficient travel modes (walking, cycling, ridesharing, public transit, and delivery services) and developing policies that favor smart growth help achieve numerous planning objectives, as illustrated in the table below. Although these strategies are not necessarily the most effective way to achieve any single objective, they are often the most cost-effective option overall to improve transportation, considering all benefits and costs.

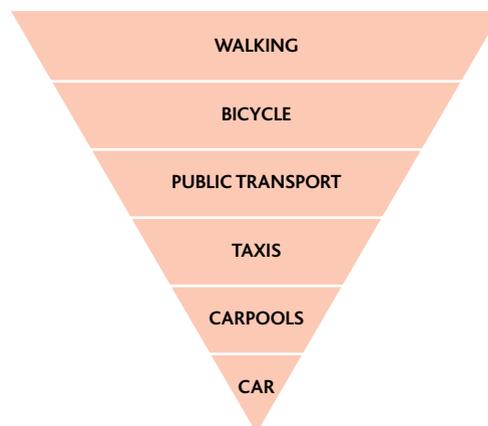
These new approaches are being applied around the world. They are particularly important in developing countries, where money is limited and most households

Figure 3: Cycle of automobile dependency and sprawl



This figure illustrates the self-reinforcing cycle of increased automobile dependency and sprawl.

Figure 4: Sustainable transport hierarchy



Transport systems are major emitters of greenhouse gases, responsible for 23% of world energy-related GHG emissions in 2004, with about three quarters coming from road vehicles. Currently 95% of transport energy comes from petroleum. Energy is consumed in the manufacture as well as the use of vehicles, and is embodied in transport infrastructure.

Source: Wikipedia.org.

In most cities prominent groups generally rely on automobiles themselves, and so tend to favor automobile-oriented improvements

cannot afford automobiles. In such conditions, active and public transport improvements tend to provide more total benefits, and have an impact on a wider range of residents than expanding urban roadways and parking facilities.

Although many cities are implementing some of these policy innovations, none are implementing all that are justified, considering all objectives. These reforms can be challenging. In most cities prominent groups, such as powerful politicians, respected professionals, and successful business people, generally rely on automobiles themselves, and so tend to favor automobile-oriented improvements. However, we can now demonstrate, using examples from some of the world's most successful and livable cities, such as Hong Kong, London, Seoul, Singapore and Stockholm, that a more diverse and efficient transport system benefits everybody, including drivers, who experience less traffic and parking congestion, and reduced chauffeuring burdens.

Urban-planning debates often reflect our prejudices about the overall goodness of humanity. Many people have a negative opinion of their fellow human beings—they would rather live in isolated suburban compounds and travel in private cars in order to minimize their interactions with other people. Urban living, walking, cycling and public transit demand more involvement with others, and so reflect a more positive opinion about humanity. People occasionally do have conflicts, but overall, most people are good and conscientious, and given the opportunity can live and travel together with consideration and respect. A neighborhood becomes safer as more responsible (non-criminal) people live, work and travel there, providing “eyes on the street” that increase security. As a result, urban planning which creates more compact, mixed and walkable neighborhoods enhance our security and spirit. In fact, considering all risks, including crime, traffic accidents and health impacts, urban living is usually safer and healthier than living in automobile-dependent suburbs.

The old transport-planning paradigm evaluated the efficiency of transport systems based on the movement of vehicles. The new paradigm focuses on moving people, and so is concerned with the travel experience, particularly for resource-efficient modes: walking, cycling and public transit. Under positive conditions we enjoy urban travel—walking down a street or having a friendly conversation with a stranger on a bus or train—and under poor conditions—inadequate sidewalks and dangerous road crossings, noisy, dirty and crowded trains—transport can be the worst experience of our week. When we ask travelers what they want, improving

comfort and convenience are often more important than increasing travel speed, which means that much of the funding currently devoted to expanding roads would be better spent improving sidewalks, reducing public transit crowding, and providing better user information for navigating around a city. These improvements are a great gift to the people who live and work in a community.

Not only can innovation create more efficient transportation systems, better transport policies can foster innovation in a community. Innovation increases when diverse people and industries locate close together, creating opportunities for collaboration (those economies of agglomeration), which is why cities exist and why productivity and innovation tend to increase with urban size and diversity. Innovation also requires affordability, the ability to live well on a modest income, and therefore the freedom to take financial risks. For every successful technology company, a city must incubate dozens of little

start-ups; and for every famous and wealthy artist, there are hundreds who struggle in poverty. Innovation requires cheap office and studio space, as well as affordable housing and transport for workers, plus plenty of social space, such as coffee shops and pubs, and opportunities for walking to inspire great ideas.

We live in a critical moment in human history—the types of cities we create now will determine the economic success and quality of life of more than half the world’s future population. It’s time to think big about small, positive changes. How can your neighborhood become a great place to walk? What could help residents take advantage of the efficiencies of cycling? How can your bus ride become the high point of your day? By answering these questions we can help create paradise on Earth.

Table 1: Identifying win-win solutions

Planning Objective	Roadway Expansion	Efficient and Alternative Fuel Vehicles	Improving Resource-Efficient Modes and Smart Growth
Congestion reduction	•		•
Roadway cost savings			•
Parking cost savings			•
Consumer cost savings			•
Increased traffic safety			•
Improved mobility options			•
Energy conservation		•	•
Pollution reduction		•	•
Physical fitness and health			•
Land use objectives			•

(• : Achieve objectives) Roadway expansion and more fuel efficient vehicles provide few benefits. Win-win solutions improve travel options and encourage more efficient travel patterns, which helps achieve many planning objectives.

Sustainable Rehabilitation

Albert Cuchí

Last year, we set a very unusual exercise for my architecture students in Sicily: combining the subjects of urban design and *restauro* (restoration, rehabilitation), it attempted to explore the choice of the best perspective from which to intervene in the rehabilitation of buildings within the urban area, the most comprehensive scale for the relevant current concerns to manifest themselves in their full magnitude, and the challenges to be confronted and for which an answer must—also—be found in architecture.

The undergraduate program in architecture at the Kore University of Enna in Sicily, which these students are currently taking, organizes its learning around the paradigm that the city must be interpreted as the result of the social metabolism. That is, of the relations of society with its environment, and the mechanisms through which society obtains the resources it needs to perpetuate itself and reproduce. Such a metabolism may be regarded as a fundamental part of any culture, by no means unrelated to the organization of society itself.

In this way, the different urban models can be interpreted as reflections of different living proposals supported by different social metabolisms. The traditional city thus becomes a product of cultures whose resources are based on management of the territory, from which its social resources are obtained. The periphery of that traditional city, itself a product of industrial culture, has been forged on the basis of urban models proposed by the city planners of the modern architecture. These proposals for new cities tried to respond to the problems of the new industrial society with the resources that this new culture placed in our hands. The *urban sprawl* became the final expression of an advanced industrial society, with infrastructures to ensure mobility and communications on a scale unthinkable some decades ago.

However, in addition to the idea of the city as the expression of its social metabolism, the problem put forward by the program is how to transform our current industrial metabolism, which has turned out to be unsustainable, into a new non-polluting metabolism based on renewable resources, a sustainable metabolism that would preserve the quality of the environment. The problem is also how to use urban habitation and intervention to assist in that transformation of the social metabolism. The courses for the program thus dwell on an analysis of the ways of life proposed in each urban model. This reveals the social metabolism that supports them and contrasts it with the demand for sustainability, and also leads to proposals to transform it, re-inhabiting

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and rehabilitating our cities, and helping with the task of achieving a sustainable social metabolism.

This year, we are working on the traditional city. This is a city based on a necessarily sustainable social metabolism, since traditional society depends on the maintenance of the productive capacity of the territory, and on the availability of resources within a closed cycle where waste must be returned to the environment in the most suitable way for it to maintain its productivity. Such a metabolism requires an intricate management of the territory, configuring landscapes whose different elements—forest, fields, meadows, kitchen gardens, farm buildings, etc.—are interlaced in complex strategies for obtaining resources while maintaining fertility.

We invited our students to select a series of materials from historic buildings and to try to recognize the landscape from which they came. They had to try to reconstruct the landscapes that produced those materials and generated the architecture, and to say where they were and how much influence they had had. The exercise was then to be completed with the selection of another series of materials, this time modern and industrial, in order to ascertain which landscape produces these new materials, and what kind of influence it has.

As a trial exercise, we worked in the first workshop of the course on the façades of the historic center of Catania, the second largest city in Sicily, selecting the most frequent materials, the ones which left the greatest mark upon the urban environment. We discovered that these materials were directly linked to two of the most memorable episodes in the history of Catania. The first was the eruption of the volcano Etna in 1669, when the city was approached by a massive tongue of lava that was diverted away from the town and towards the sea thanks only to the city walls. The second was the complete destruction of the city a few years later, in 1693, by an earthquake, and the subsequent reconstruction of the *settecento* historic center we see today.

The students discovered that lava stone, the cold and solidified residue of the volcanic lava that had menaced the city, formed an essential part of the material with which Catania was rebuilt. Together with what remained of the city that stood before the earthquake, the hard stones from the lava that reached the city in the eruption of 1669 were used for paving and for the buildings' walls. The softer and more porous stones from the eruption were used to make sand for facing walls, giving the *intonaco* (plaster) of the urban façades of the

historic center their characteristically grey color. Furthermore, the clay from the countryside around the city, baked by the burning tongue of lava during the eruption, originated a building material of characteristics similar to the Roman *puzzolana*, which was obtained by excavating the clay from underneath the crust of solidified lava. The pink facing on many walls was produced with that material, and even today the black of lava and the grays and pinks of the façades are the specific colors of Catania, used also in modern constructions as a sign of identity although now obtained from other materials.

My students must next work on their own city of Enna, in the center of Sicily, and select the materials that were used to construct some of its historic buildings and make them inhabitable. They will discover that the city, located on a mountain like so many others in Sicily, grew by excavating the materials for its walls from the rock itself. They will wonder about the forests that produced the wood to build the ceilings. Where are the forests of Sicily today? And what was their relationship with crop farming, and with the famous Sicilian wheat that used to supply Rome? And with the wood used for baking lime? And for heating? They will also wonder about the water, including both the water drunk by the inhabitants and the rain water that fell on the roofs. And on the streets of the city, which formed stream beds organized to manage and take advantage of the water they drained away.

By looking at such things, they will have already noticed that the streets of Enna, their own city, are paved with lava stone from Catania. How and when did it get here, eighty kilometers away from the volcano? It arrived with the railway, when the industrial revolution made communications easier and allowed heavier and cheaper materials to be transported over longer distances, enlarging the landscapes from which cities were constructed and broadening the mark of their social metabolism, up to the point where it has now become global. This, however, was made possible by burning coal to fuel the railway, thus reducing transportation costs by externalizing other costs, which we are now starting to pay in the form of climate change.

When my students analyze the landscapes that built the historic city, they will discover some that were close at hand, and will see how closely intertwined the different elements of those landscapes were with the different resources society obtained from them. They will understand how closely imbricated the production of architecture was with the fulfillment of other social

The different urban models can be interpreted as reflections of different living proposals supported by different social metabolisms

needs, and to what point the urban metabolism was connected with its own territory.

And also how distant are the landscapes which contain today's construction materials, like cement and steel. How far off in space and time—eons since their formation—are the fossil energy resources used to produce them, just as the effects they will have on the climate will reach the farthest limits of time and space. And it is the same energy as is used to make the buildings comfortable, or to bring water to people's dwellings, or to activate the infrastructures that support our urban metabolism. How remote and tremendous are the landscapes formed by the bauxite mining that supplies the aluminum for our windows. It is no longer under our own feet, nor does it organize our lives or activities, but it does affect other lives of which no news reaches us. We must recover the space and time of our way of life. That is sustainability.

Half the world's population now lives in cities. From now until 2050, the population is expected to grow by the equivalent of the current populations of China and India. This growth will occur in cities, and mainly in cities that already exist and are going to expand and become transformed. These cities are the reflection and the result of the ways of life that have created and used them, of society's relationship with the environment, and of their social metabolism.

The challenge will make it obligatory to transform cities, re-habilitate them (that is, restore their *habilitas*, or ability) to take in people who have mostly emigrated from the countryside to the city, or have formed part of the great migratory processes that are shaking the world and are largely due to the transformations brought about by our unsustainable industrial system of production, now globalized. These cities, then, must be cultural crucibles, confronting their challenges with the social and human capital of these people from different cultures who have been forged by very diverse landscapes, and who forge them in their turn.

At the same time, such cities must undergo the challenge of transforming their social metabolism. As the space of our global culture, cities are going to be the setting, indeed the battlefield, where the change in production models toward sustainability will take place. This is so because they are high-density nodes of our social metabolism, and because they are the places where the conscience of the citizenry has the best perception of what is happening in the public space within them.

The challenge of sustainability has strong urban expression in all the areas that define the city. Obviously, this includes building. For example, if we do not bring about a much more profound change than we are now doing in the way we construct buildings and keep them inhabitable, the provision of housing for the increased population in 2050 will demand of the construction sector all the greenhouse gas emissions that will be admissible that year if we are to keep the rise in the planet's global temperature below two degrees Celsius. This is a giant challenge, and all the more so if we consider that it is one that also faces mobility, food, education, and many other goods and services necessary for living with dignity.

The increase in urban population over the next 35 years from today's 3.6 billion to 6 billion will not only engender an urban crisis, but must also be accompanied by the necessary change toward the sustainability of the production model.

It is for this reason that the understanding of a city as a product of the social metabolism, as the expression of a productive landscape where society's relationship to the environment is visible, has so much value today. Remaking cities to cope with exceptional growth, and doing so while transforming our model of production toward sustainability, requires networks that relate city and productive model, and resources with which to weave and unweave those networks. These are cultural resources which largely arrive with the new urban population. They come with them, entwined in tangles of knowledge which have to be wound into new frames with a new way of re-habilitating and reinhabiting cities.

Perhaps the image of Catania threatened by the lava of Etna in 1669 is a good analogy for the situation of cities today. Confronted with a huge challenge—that of emigration toward the cities, which seems about to destroy them—they may find that it actually permits the reconstruction that is so badly needed to face a still greater challenge.

For their last paper of the year, my students have to propose rehabilitation projects for the buildings they have been working on. They have to propose uses, and obviously, they must suggest strategies so that those uses will be suitably and sustainably implemented, with renewable resources and integration in a non-polluting social metabolism. They must be aware, however, that they are contributing with those resources to the construction of a new landscape, one in which their building resource strategies must link up with other

resource strategies (food, mobility, etc.), and that their task, and the work they will have to carry out in the future as architects, is none other than the construction of a new landscape, the product of a new social metabolism.

Believe me, I am anxiously awaiting the results of their work.

Playground

James Mollison

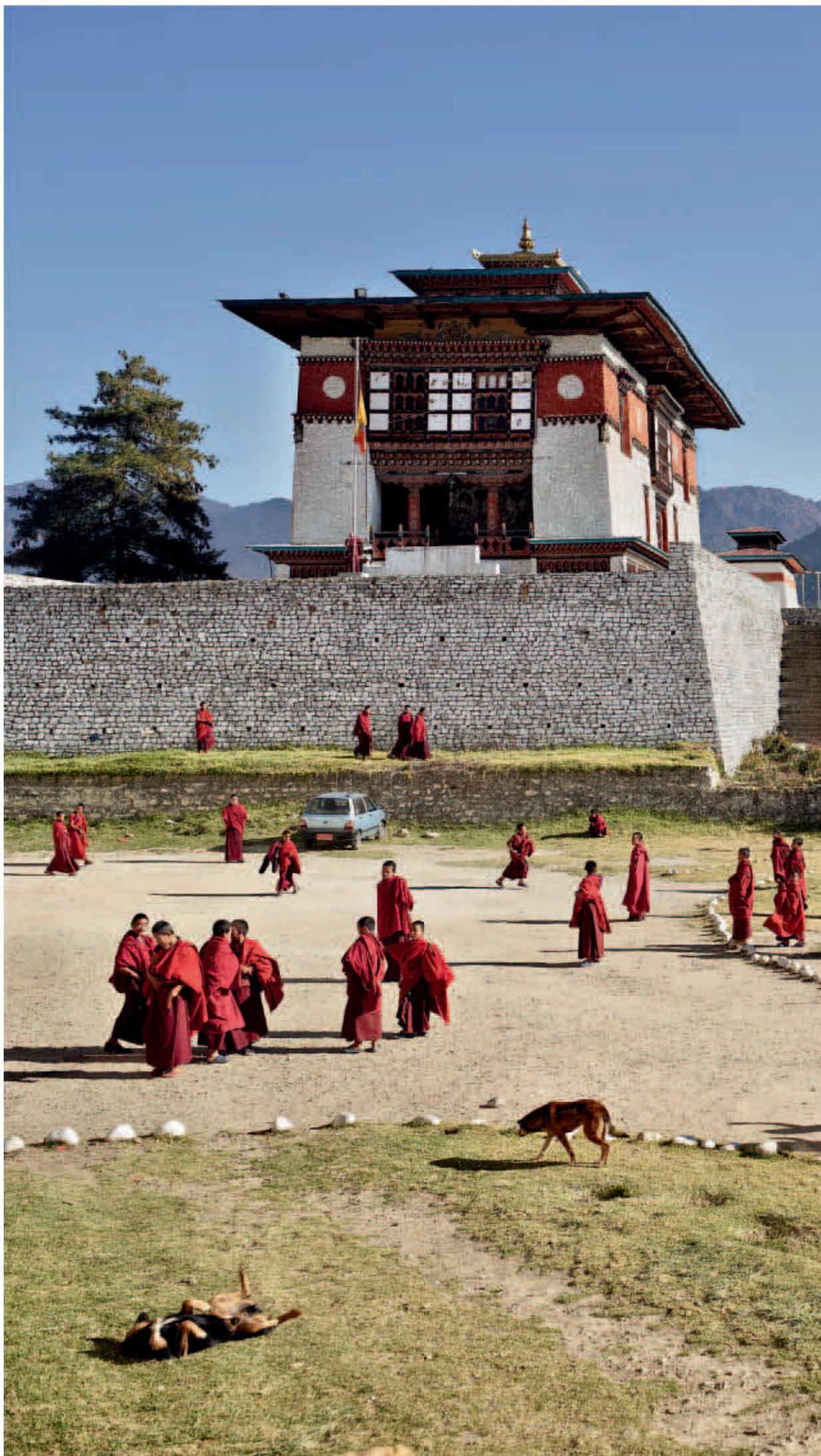
James Mollison (Kenya, 1973) confirms that “play is incredibly universal” in *Playground*, a photographic series that shows scenes of school playgrounds in different parts of the world. Emphatically general though these views are, it is the details that show up the disparities between the socioeconomic and political environments of the playgrounds, but also the little difference there is in the behavior of children when the bell rings for the break.

Westminster School, London, 2010





Dechen Phodrang, Thimphu, Bhutan, 2011

















Freretown Community Primary School, Mombasa, Kenya, 2011





Affiliated Primary School of South China Normal University, Guangzhou, China, 2014





正 气 ， 法 古 今 完 人 。

志在千里
行在脚下
拼搏进取
自强不息

更快 更高 更强





Management therefore needs to evolve toward an understanding that ecosystems and natural water supply networks are not competing with it for the resource, but are its closest ally when it comes to capturing, storing, channeling and purifying water

Yolanda Kakabadse

Efficiency is thus really better described as “more with less.” There are very simple steps to achieve efficiency, both at home and in businesses and industries, such as updating or replacing separate systems or appliances that will save both money and energy

Sven Teske

3. *Water, Renewable Energy and Infrastructures*

Individuals and societies inscribe their values, beliefs, ideas, and identity in the landscapes they create, leaving a legacy of stories told and read through a language of landscape

Anne Whiston Spirn

The cities at the forefront of the promotion of biodiversity in urban areas have a responsibility to share their experience with other cities in the world

Ahmed Djoghla

Caring for Natural Water Supply Networks

Yolanda Kakabadse

We are living through extraordinary times. For the first time in history, humanity has started not only to become aware of its ability to transform life on Earth, but also to reflect seriously on the enormous possibilities and benefits of constructing a new economic ecosystem that will take people and their planet into account.

This is today one of the great priorities of the organization I preside: to help create an economic model based on a new way of measuring prosperity and success in which social welfare and natural capital will be indicators of an importance equal to or greater than income or consumption, which we currently use to measure the level of development.

We are therefore working all over the world for the recognition of the importance of biodiversity and ecosystems as the guarantee of a prosperous future that will provide food, water and energy for the nearly ten thousand million people who will be sharing our planet in 2050.

These are enormous challenges, and although major progress has been achieved, we know it is not enough and we can do a great deal more, especially if we manage to join forces and create alliances with governments, businesses and civil society, which is already mobilizing in strength around the planet. The key at this moment in history is to keep adding to these forces, and this has become the central focus of the WWF's work for the next few years.

Fortunately, things are changing and we are promoting and supporting positive experiences around the world that show it is possible to satisfy requirements for such vital natural resource as water while preserving the health of the rivers, wetlands and lakes it comes from.

To be able to manage resources without destroying them and take the right decisions for improving our quality of life, we need more precise knowledge of their location and their evolution under our ecological footprint. At WWF, we have therefore been presenting the biannual *Living Planet Report* for nearly two decades, with data intended to help all of society, but especially political leaders, managements and businesses, to take more informed and responsible decisions on our environment.

The eleventh edition of this prestigious report was recently presented throughout the world. It contains an exhaustive scientific analysis carried out, as with the previous reports, in conjunction with the Global Footprint Network and the London Zoological Society, which

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permits us to measure the evolution of the planet's health and natural riches.

With this report, we try to present an overall view of the state of nature throughout the world. To obtain this, we examine the tendencies of nearly 15,000 populations of over 3,700 species, which also allows us to display a reliable image of the state of the ecosystems they live in and the impacts caused by human beings.

Unfortunately, the conclusions cannot be more alarming. The world populations of fish, amphibians, reptiles, birds and mammals diminished by nearly 58 percent between 1970 and 2012, and by 2020, if the current trend continues, they will foreseeably have diminished by up to 67 percent, the principal causes being the loss and degradation of habitats and the over-exploitation of species. This is endangering the basis of the natural resources and services that ecosystems offer us.

The most recent data on our ecological footprint also show that we are asphyxiating the planet for the first time in history, since in order to satisfy our current needs, humanity is consuming a quantity of natural resources equivalent to 1.6 planets. If we continue at this rate, we shall need 2.5 planets by 2050 to meet human demands.

There is no doubt that humanity's relationship with nature and the planet has already changed profoundly, and that we have entered the Anthropocene era, an epoch marked by grand transformations on a planetary scale, noticeable within a single generation and unforeseeable in their consequences.

One of the most disturbing and striking conclusions of our survey of nature is that there is a dramatic and alarming descent in populations of freshwater vertebrates, which have fallen by 81 percent, while populations of terrestrial species have diminished by 38 percent, and of marine species by 36 percent. This clearly shows the profound degradation of aquifers, rivers, lakes and wetlands around the world.

On this occasion, we have placed the emphasis of the *Living Planet Report* on the impact of the current food system on nature, showing it once again to be clearly unsustainable. Agriculture already occupies a third of the surface area of land on the planet, and is responsible for 69 percent of fresh water extractions. Together with the rest of the food system, it generates nearly a third of greenhouse gas emissions. We can state without question that we produce badly and eat worse, and that we waste our food in spite of its cost, since a third of it ends up in the garbage.

The intensive use of water for agriculture, pollution, and the construction of massive infrastructures that are transforming and fragmenting rivers are the principal causes of the disappearance of biodiversity and the profound degradation of the freshwater ecosystems that are vital for our economy and well-being.

However, the *Living Planet Report* also presents real solutions and alternatives within the reach of all to ensure there will be enough water for our needs while preserving the health of the rivers, lakes and wetlands it comes from. Examples include the application of more efficient and intelligent irrigation systems, or improving the planning and governance of water with greater participation by all the agents involved so that river basins will be managed as the complex and hugely diverse living systems they are.

When we talk of "water supply networks" we traditionally refer to the set of infrastructures—dams, canals, pipelines, reservoirs, water treatment plants—that make it possible for drinking water to reach our cities and homes, nearly always forgetting that water does not come from a tap. It comes from ecosystems, and from nature.

Forests, rivers and wetlands are essential components of living networks, which are much more complex than artificial ones, and make it possible for human beings to have water available for drinking, irrigation or manufacture, and even for inspiration, enjoyment or prayer. Healthy aquatic ecosystems are the sole guarantee for possessing water resources of sufficient quality and quantity for current uses and those of future generations.

While water supply networks formed by concrete infrastructures are faced with the challenge of modernization in order to reduce losses and profit better from the resource, the water supply networks of nature have to cope with increasing pressure from human beings, who mistreat them as badly as they need them.

Throughout their history, humans have intervened at will in the natural water cycle with the aim of better using resources. The courses of rivers have been modified and fragmented by large infrastructures in order to accumulate their water and place it at the disposal of demand whenever necessary. Nearly half the volume of water of the world's rivers has been altered by regulation work. When this is not enough, we transfer water from one hydrographic basin to another, perpetuating unsustainable models, instead of adapting development to endogenous capacities. And we pump water from deeper and deeper aquifers, exhausting fossil resources to satisfy unsustainable demands. Some rivers no longer reach the

Agriculture already occupies a third of the surface area of land on the planet, and is responsible for 69 percent of fresh water extractions. Together with the rest of the food system, it generates nearly a third of greenhouse gas emissions

sea because their water resources are completely exhausted along their course. In other cases, the waters are so polluted that few species can survive.

According to the World Economic Forum, the water crisis is one of the greatest risks facing humanity on a global scale. The growing scarcity of water in more and more areas of the planet is not a problem of the quantity of water but a reflection of the imbalance between demand and available resources. While there were thirty countries in 1992 that suffered from water shortage or stress, the figure had climbed to fifty by 2014. Guaranteeing affordable water for all, free of pollution and sustainably managed, is in fact one of the key points on the global agenda and the new Sustainable Development Goals adopted by the United Nations.

Moreover, as our *Living Planet Report* shows, we have propitiated and spread a model of production of energy, food and other goods that demands more and more investment in infrastructures. Products irrigated with local water are consumed in a global market, but the impact on hydro resources and the energy footprint is seldom internalized in the real cost of these resources, nor does it find reflection in the final price of the products.

The “cheap” consumer goods enjoyed by the most developed countries are in fact very expensive, since the non-inclusion of negative production externalities stimulates the continual construction of new infrastructures to supply water or produce energy, and so backfeeds a perverse system. A mirage of free and infinite water is created, allowing and fostering an unsustainable growth of its consumption around the world, and causing shortages that eventually affect the population in producing countries.

The planet does not have as much water as can be stored or transferred by artificial infrastructures, but as much as nature can give us. We have to agree on limits for extracting it which will allow the hydrological cycle to be maintained in healthy and functional conditions, with water of sufficient quantity and quality in drainage basins and aquifers. Such agreement on limitations is vital because it is the water maintained in nature that will allow the ecosystem to keep functioning, and so permit the resource to be managed suitably.

We humans demand water from nature without stopping to think how essential it is for the quality and degree of the conservation of the biodiversity and ecosystems that produce, purify and transport it. But we have caused such severe impacts on aquatic ecosystems that it is

increasingly difficult to obtain enough water to satisfy our basic needs.

Investment in the ecological restoration of natural water networks and green infrastructures should be a priority for all water-related public and private sectors, since when they function correctly, they provide high-quality water, prevent serious natural catastrophes like floods, and reduce damage and maintenance costs for artificial infrastructures and networks.

It is unfortunately not always possible to restore nature to its original state, but many of the wounds caused by human activity can be healed. Thus, degraded and even destroyed river ecosystems can be revived. However, most investment is still aimed at the construction of artificial networks, and only a marginal effort is currently being made to preserve and recover natural infrastructures.

We are already experiencing the first impacts of climate change, one of whose most serious manifestations will be the modification of the water cycle in many parts of the planet, with variations in precipitation patterns, evaporation and water temperature that will have grave consequences for ecosystems, biodiversity and the subsistence of hundreds of millions of people whose lives, in one way or another, are closely linked to water.

In the face of this threat, the solution currently proposed is to pour the scant available resources into the construction of new infrastructure. If all the dams currently planned or under construction for hydroelectric power or irrigation were finished, we would lose 93 percent of the natural volume of water of the world's rivers.

From our point of view, the chief investment should be dedicated precisely to a massive deployment of renewable energies, a reduction in water consumption through innovation in more sustainable forms of production, and the restoration of degraded ecosystems in order to increase their resilience to climate change and allow them to continue to provide their services as naturally as possible. Investment in infrastructures and artificial networks should be left for those cases where they are accredited as necessary to ensure supply or treat waste.

Finally, it is vital to change the current perspective of most public administrations and of the private sector, which apparently still believe that the water in our rivers should be used up to the last drop, on the grounds that it ought not be allowed to be “wasted in the sea,” instead of accepting the necessity of leaving enough water for natural processes and biodiversity to complete their cycle.

At the same time, it is essential to make progress in the effective conservation of drainage basins, making firm efforts to create new protected areas where the collection and purification of water will be guaranteed throughout the system, and also to provide other services contributed by the ecosystems. Management therefore needs to evolve toward an understanding that ecosystems and natural water supply networks are not competing with it for the resource, but are its closest ally when it comes to capturing, storing, channeling and purifying water, and that there are other vital objectives to be fulfilled, such as the transport of sediments and the connectivity and mobility of the species that give the river its life.

When one lives in a city like mine, Quito, where the supply of something as vital as water is closely dependent on the health of an ecosystem as fragile as the plateaus that capture water from the atmosphere and act as hydraulic regulators that stabilize the water volume of rivers, it is easy to appreciate the importance of viewing natural water supply networks from an integral perspective, preserving them so that they can fulfill their function as “water factories,” and tackling the wide range of threats they face, climate change included.

Fortunately, there is for the first time a consensus among governments, the private sector and society as a whole on the need for change, and this is permitting progress that was unthinkable only a short time ago. Examples include the Paris Agreement on climate change; the approval of the Sustainable Development Goals, which for the first time bring together the economic, social and environmental agendas; and the New Urban Agenda, the result of the Habitat III summit held in Quito. They will prove enormously important for improving the management of water across the planet.

An evolution away from our current unsustainable use of water is the responsibility of all, and our success will depend on whether we are able to change quickly and in unison towards a model of development respectful of the nature and ecosystems which maintain our society and economy. Only by giving top priority to the care and restoration of the ecosystems that form natural water supply networks will our children and grandchildren be as fortunate as we are in continuing to enjoy the so-called “blue gold” of the twenty-first century.

The Future of Renewable Energies

Sven Teske

Over the past decades significant progress has been made in the development of renewable energies, and technologies are now mature. Especially wind and solar photovoltaic power have achieved economies of scale through a combination of market support programs, technology improvements and mass production; the renewable energy industry has successfully moved into the mainstream. However, compared to the vast global potential of all renewable energy sources, the current market volume shows only a glimpse of what it could be in the future. While wind and solar photovoltaic power dominate the discussion around renewables, there is a huge variety of different technologies available, and each technology has a specific area of application.

Towards a Global Share of 100 Percent Renewable Energy Supply

The Intergovernmental Panel on Climate Change (IPCC) published in 2012 the most comprehensive data collection report about renewable energy currently available—the *Special Report on Renewable Energy* (Edenhofer et al. 2012). According to this survey, renewable energy technologies available today could supply two and a half times the present total energy demand from China or Europe, while Africa could generate two hundred times its energy demand with renewable energy. Thus, renewable energy potential is not a limiting factor to achieve full global supply.

Despite the Huge Renewable Energy Potential, Less Is More

Using energy efficiently is cheaper than producing new energy from scratch, and often has many other benefits. An efficient washing machine or dishwasher, for example, uses less power and saves water too. Efficiency in buildings doesn't mean going without comfort—on the contrary, it should provide a higher level of comfort. For example, a well-insulated house will feel warmer in the winter, cooler in the summer and be healthier to live in. An efficient refrigerator is quieter, has no frost inside or condensation outside, and will probably last longer. Efficient lighting offers more light where you need it. Efficiency is thus really better described as “more with less.” There are very simple steps to achieve efficiency, both at home and in businesses and industries, such as updating or replacing separate systems or appliances that will save both money and energy. The biggest savings, however, don't come from incremental steps but from rethinking the whole concept—the whole house, the

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whole car or even the whole transport system. In this way, energy needs can often be cut back by a factor of four to ten. Energy efficiency is based on the following pillars:

- The implementation of best practice technologies and a certain share of emerging technologies, observing energy efficiency standards.
- Behavioral changes, e.g. reducing the average room temperature.
- Structural changes, such as shifts from individual fossil-fuel cars towards electric public transport.
- Updating equipment and installations, replacing them at the end of their (economic) lifetime, e.g. switching to LED lighting.

Thus energy efficiency is not a homogenous sector, and involves a large number of technologies and measures. While the renewable energy markets can be clearly defined with a small amount of technical and financial parameters, measuring the development of energy efficiency is complex. Without energy efficiency, the global demand would be 826 EJ/a – 251 EJ/a higher than today. In other words, the energy efficiency measures of the past twenty-five years saved the equivalent to China, India and Europe's energy demand combined. Between 1990 and 2014 global primary energy intensity dropped continuously for more than two decades by an average annual rate of 1.5 percent. In 2015 energy intensity was more than 30 percent lower than in 1990. Nonetheless, global economic growth has been far greater, resulting in steady net growth in energy demand, which increased by 56 percent between 1990 and 2014 with an average annual growth rate of 1.9 percent.

Sectorial Changes

Within the energy industry, the power sector experienced the most rapid changes over the past decade. Wind power is now among the cheapest new power plant technologies, and solar photovoltaic systems achieved grid parity in many countries. In 2015, every second newly built power plant was based on renewable energy technologies. The development of wind and solar photovoltaic power has been outstanding, and it already has significantly changed the way utilities operate.

In 2015, about half of the total world final energy consumption was used to generate heat (REN21 2016). The overall global consumption of heat energy over the past decade, however, only grew at an average annual rate

of less than 1 percent. While cooling demand continues to increase as a result of improved energy access—mainly in developing countries with warm climate and rising average global temperatures—the proliferation of highly energy-efficient buildings and passive solar architecture contributes to reduce heat demand. In the building sector, biomass and solar thermal energy account for the vast majority of modern renewable heat. By contrast, in the power sector the available statistical data for heating consumption is incomplete. Bioenergy dominates renewable heat production in the industry sector with around 10 percent of total demand.

While renewable power generation continues to enjoy double-digit growth rates, renewable heating and cooling technologies have grown at a much slower rate. This is partly due to the small-scale nature of this sector, as well as the multiple decision-making processes encountered primarily at the customer level. More complex, and therefore fewer, renewable energy support policies have also hindered growth in this sector.

But the greatest challenges in the switch from fossil fuels to renewables are found in the transport sector. There are three main entry points for renewable energy in this sector: the use of 100 percent liquid biofuels or biofuels blended with conventional fuels; the growing role of natural gas vehicles and infrastructure that can be powered with gaseous biofuels; and the increasing electrification of transportation.

A transition towards 100 percent renewable energy starts with a technical and modal shift. Three main measures must be adopted in order to develop a more energy-efficient and sustainable transport system in the future, with a focus on:

- Reducing transport demand.
- Shifting transport modes from high to low energy intensity.
- Improving energy efficiency through the development of technology.

The remaining energy demand will have to be fulfilled using sustainable biomass and by replacing combustion engines for electric drives in multiple vehicles. However, the shipping and aviation sector in particular, but also heavy-duty trucks and construction vehicles, cannot be electrified with the technologies currently available. Thus, fossil fuels must be replaced with synfuels, hydrogen and renewable methane produced from renewables. Electricity is required to produce these fuels, which will significantly

increase future electricity demand. The European Environment Agency (EEA) commissioned an assessment that calculated the future impacts of greater electric vehicle use on Europe's energy system, and associated emissions from the road transport and energy sectors (EEA 2016). Should the share of electric vehicles in Europe rise to 80 percent by 2050 the electricity demand will rise significantly. According to the research, the share of Europe's total electricity consumption from electric vehicles will increase from approximately 0.03 percent in 2014 to around 4–5 percent by 2030 and 9.5 percent by 2050. By 2050, an additional power plant capacity of 150GW would be needed in order to charge all the electric cars of the European Union. Furthermore, this additional energy needs to be integrated into the grid infrastructure across Europe. The critical matters raised by this assessment are therefore how much electricity will be needed to cope with Europe's added demand, what type of generation is used to cover this additional electricity demand, and how could charging peaks be managed.

Balance Variable Wind and Solar Generation with Inter-Sectorial Management and Storage

Currently, the power, transport and heating sectors are to a large extent separate, due to the different energy sources and infrastructures relevant to each of them. While the power sector is limited to the power grid, the heating sector depends largely on gas grids and—in some cases—district heating pipeline systems. The transport sector is currently disconnected from both the power and heating sectors, with its infrastructure primarily focused on the distribution of oil via tankers, pipelines and filling stations. Public transport, on the other hand, does already have links to the power sector, as the electricity used in trains, trams and the metro systems originates from the power sector.

With increased electrification, the power sector will progressively merge with the heating and transport sectors. At the same time, renewables do not need fuel, which will have a significant influence on oil, gas and coal mining companies. Finally renewable power generation—especially solar photovoltaic energy—may move closer to consumers and, if decentralized renewables continue to grow, may generate electricity in small units on the side of demand. Should this be the case, the capacity of a single centralized conventional power plant would be distributed across several thousand locations, which would require a significant change in the business model of traditional utilities.

Technology Trends for Renewable Power Management

Increased market share of renewable energies in the power sector necessitates more infrastructural changes and new power grid management. However the task of integrating renewable energy technologies into existing power systems is similar in all power systems around the world, whether they are large, centralized systems or island ones. Thorough forward planning is needed to ensure that the available production can match demand at all times. In addition to balancing supply and demand at all times, the power system must also be able to fulfill defined power quality standards such as voltage and frequency stability, which may require additional technical equipment in the power system and support from different ancillary services. Furthermore, power systems must be able to cope with extreme situations such as sudden interruptions of supply in case of a fault at a generation unit or interruption of the transmission system.

The integration of renewable energy into a smart grid changes the need for base load power. In countries such as Spain, Denmark and Germany as well as in South Australia, wind and solar power plants already provide more than 30 percent of daily demand on certain days. This redefines the need for base load power. Instead, the load has to be followed in the daytime and the night by a combination of flexible energy providers, such as solar photovoltaic systems complemented by gas, geothermal and wind sources, and demand management. Such a mix of different technologies can form a resilient power supply, but requires a significant change in the business model of utility companies.

Storage Technologies: The Cascade Approach

Once the share of electricity from variable renewable sources exceeds 30–35 percent, energy storage is necessary in order to compensate for generation shortages or to store potential surplus electricity generated during windy and sunny periods. Today, storage technology is available for different stages of development, scales of projects, and for meeting both short- and long-term energy storage needs. Short-term storage technologies can compensate for output fluctuations that last only a few hours, whereas longer term or seasonal storage technologies can bridge the gap over several weeks. There is no one-size-fits-all technology for storage. Along the entire supply and demand chain, different storage technologies are required to cover the exact needs in regard to storage time—from second reserve for frequency

stability to seasonal storage of several months. A cascade of different storage technologies is required to support the local integration of power generation from variable renewable energy (VRE) in distribution networks, support the grid infrastructure to balance VRE power generation, and support self-generation and self-consumption of VRE by customers.

Generation Side Management for 24/7 Supply

Load varies over time and additional flexible power generating resources are required to provide the right amount of power. For rural areas, typical technologies are combined-cycle gas turbines (CCGT) or hydropower stations with a sufficient storage capacity to follow the daily load variations. The impact of adding renewable power generation to a conventionally centralized power system will affect the way in which a conventionally designed electricity system runs. The level of impact depends on the renewable energy technology (Teske et al. 2014). Biomass-, geothermal-, concentrated solar power plants (CSP) and hydropower with storage can regulate power output and can supply both, base and peak loads. Meanwhile solar photovoltaic, wind power and hydro power plants without storage depend on available natural resources, so the power output is variable. Sometimes these renewable energy sources are described as “intermittent” power sources; however, this terminology is not correct as intermittent stands for uncontrollable and non-dispatchable. In fact, the power output of these generation plants can already be forecasted with a high degree on certainty and power output can be reduced, hence they can be dispatched.

The Energy System of the Future Uses Cross-Sectorial Demand and Supply Management

New (battery) storage capacity is still expensive and unable to provide long-term seasonal storage; the most efficient hydro pump storage facilities cannot be expanded everywhere. Therefore, the interconnection of power grids with district heating pipelines, gas pipelines (for power-to-gas) and railway power lines offers a vast range of new possibilities. Storage of “surplus” wind and solar power in the form of heat via heat pumps or gas via electrolysis or in the batteries of electric vehicles, as well as demand management of numerous applications help to integrate more variable power generation capacity. The future energy system uses the full range of technologies across all energy sectors to distribute generation and manage

demand. A utility company will therefore develop new business concepts and related support policies. The real challenge might not be the technologies, but a stable and consistent policy framework, which requires long-term thinking. The interconnection of systems offers new business opportunities and will most likely lead to a more resilient energy supply.

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Landscape Literacy and Design for Ecological Democracy

Anne Whiston Spirn

Nature is the word Raymond Williams called “perhaps the most complex word in the [English] language” (Williams 1983, 219). It originally described a quality—the essential character of something. Nature is an abstraction, writes Williams, a set of ideas for which many cultures have no one name. The abstraction of the word itself conceals radical differences in definition from culture to culture, even among individuals within the same culture (Spirn 1997).¹

For me, nature is not a place, like a park or a wilderness, and not a particular feature, like a tree or a river. For me, nature consists of the creative and life-sustaining processes that connect everything in the biological world and the physical universe, including humans. These chemical, physical, and biological processes interact with social, economic, political, and cultural processes, over time, to produce landscapes. I use the word *landscape* as freely as I use *nature* sparingly, for I hope to recover the original meanings of the word in Old English and Nordic languages: the mutual shaping of people and place (Olwig 1996; Spirn 1998). Landscape, in its original sense, is not mere scenery. It encompasses both the population of a place and its physical features: its topography, water flow, and plant life; its infrastructure of streets and sewers; its buildings and open spaces.

Individuals and societies inscribe their values, beliefs, ideas, and identity in the landscapes they create, leaving a legacy of stories told and read through a language of landscape with its own elements, pragmatics, and poetics (Spirn 1998). The language of landscape is a powerful tool. It permits people to perceive pasts they cannot otherwise experience, to anticipate the possible, to envision, choose, and shape the future landscape.

Since 1987, West Philadelphia’s Mill Creek watershed and neighborhood (among the poorest in Philadelphia) has been my laboratory to test and generate ideas about the landscape language, landscape literacy, the “three E’s” of sustainable development (environment, economics, and equity), and what Randolph Hester has called “ecological democracy,” or how to restore urban ecosystems and rebuild community in synergistic ways (Spirn 1998; Hester 2010).² Landscape literacy enabled Mill Creek residents to read the environmental, social, economic, and political stories embedded in their local landscape and gave them a way to formulate new stories, to envision how to transform their neighborhood, to both challenge and work with public officials.³

Reading the Landscape of Mill Creek

The landscape of West Philadelphia’s Mill Creek neighborhood is a catalogue of the failures of twentieth-

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century urban policy, planning, and design.⁴ The US Federal Housing Administration's guidelines for underwriters, first spelled out in the 1930s, included the race of a neighborhood's population and the age of its buildings; these guidelines contributed to redlining, the banking practice of refusing to grant loans for the purchase of properties on the basis of location (Hillier 2003). Urban renewal projects of the 1950s, such as the public housing towers inserted into this neighborhood of small-scale rowhouses, had devastating effects on the place they sought to improve and contributed to the racial segregation of a neighborhood where blacks and whites had lived next door to one another, in identical rowhouses, for at least a century. New parks, playgrounds, and streetscapes built in the 1960s cracked and subsided within a few decades of construction, and a public housing project built in the 1950s was demolished recently.

Mill Creek is among the poorest neighborhoods in Philadelphia, yet it is home to many well-educated, middle-class residents, almost all African-American. Boarded-up storefronts speak of failed ventures, but other institutions, like the numerous community gardens, flourish. Blocks of vacant land and wasted structures border blocks of well-tended houses and gardens. There are patterns to how and where abandonment occurs. Such patterns reveal the nature of Mill Creek and are key to its future (Spirn, Pollio and Cameron 1991).

The single feature of the Mill Creek landscape that has had the most significant, persistent, and devastating effect is the least recognized: the buried floodplain of the former creek (from which the neighborhood takes its name) and the hydrological processes that continue to shape it.

The Mill Creek once drained about two-thirds of West Philadelphia, and its sewer still does. The creek itself once flowed above ground, the water's erosive force in main channel and tributaries cut valleys from its tributaries in the north to its mouth at the Schuylkill River.

By the late nineteenth century, the creek was polluted by wastes from slaughterhouses, tanneries, and households. In the 1880s, it was buried in a sewer, its floodplain filled in and built upon, but it still drains the storm water and carries all the wastes from half of West Philadelphia and from suburbs upstream. Each new suburb built in the watershed poured more sewage and storm water into the sewer. The size of the pipe—about twenty feet in diameter—is now too small for the quantity of combined sewage and storm water it must convey after major rainstorms.

Over the course of the twentieth century, the ground fell in, here and there, along the line of the sewer. The creek undermined buildings and streets and slashed meandering

diagonals of shifting foundations and vacant land across the urban landscape.

In 1945 Pennsylvania enacted enabling legislation for federally-funded redevelopment under the Urban Redevelopment Law. Three years later, the city designated the Mill Creek neighborhood as a redevelopment area and hired architect Louis Kahn to produce a plan. In 1950, following a sewer collapse near 47th and Fairmount Streets, Kahn was also commissioned to design the Mill Creek Housing Project on several square blocks near the cave-in. The public housing was built, as were play fields and ball courts on other blocks that had fallen in. Land directly over the sewer pipe was maintained as open lawn or parking lots, but much of the public housing was built on the buried floodplain. There have been no major cave-ins in recent years, but sinking streets, playgrounds, and parking lots and shifting building foundations continue to plague the area. Between 1950 and 1970, the overall population of the Mill Creek neighborhood declined by 27 percent. Given the outward flow of population and capital and the inward flow of sewage and groundwater, the abundance of vacant land and deteriorating or abandoned properties in Mill Creek, by the 1980s, was not surprising.

The West Philadelphia Landscape Project

For nearly thirty years I have worked in and studied Mill Creek, both the neighborhood and the larger watershed: first, from 1987 to 1991, as part of a larger landscape plan and "greening" project for West Philadelphia; then, since 1994, as the primary focus of my research. By the end of the first phase of the West Philadelphia Landscape Project in 1991, my students, colleagues, and I had made proposals for the strategic reuse of vacant urban land in the Mill Creek watershed and had designed dozens of gardens (Spirn and Pollio 1990; Spirn, Pollio and Cameron 1991, Spirn 1991). During the first phase of the project (1987–1991), and for years following, I had hoped to convince the City Planning Commission and the Philadelphia Water Department that the buried creek was both a force to be reckoned with and a resource to be exploited, but, when the city's *Plan for West Philadelphia* was published in 1994, it failed to mention the buried floodplain and the hazards it posed. That same year, the city donated a large parcel of vacant land for the construction of subsidized housing for first-time, low-income homeowners. This latter project was especially troubling, for the site was on the buried floodplain.

When the West Philadelphia Landscape Project began in 1987, I did not intend a long-term involvement. However, the City Planning Commission's disregard for the health, safety, and welfare of Mill Creek residents renewed my

There is an even greater injustice than inequitable exposure to harsh conditions: the internalization of shame for one's neighborhood

commitment. It also prompted new realizations that both sharpened and enlarged the questions my research sought to answer. Confronted with skepticism about the existence and dangers of the buried floodplain, I began to understand this resistance as a form of illiteracy—an inability on the part of public officials, developers, and even Mill Creek residents themselves to read the landscape.

I organized my teaching and research to explore these issues. From 1994 to 2001, students in my classes at the University of Pennsylvania and at the Massachusetts Institute of Technology analyzed the urban watershed, demonstrated how storm water could be collected in landscape projects that are also stormwater detention facilities, and created designs for wetlands, water gardens, and environmental study areas on vacant land in the Mill Creek neighborhood. When the West Philadelphia Landscape Project website was launched in early 1996, it featured the database, reports, and projects built from 1987 to 1991. Since then, it has been a showcase for ongoing work (www.wplp.net).

To reach a broad spectrum of the Mill Creek population, my students and I launched a program with a public school in the Mill Creek neighborhood. What began as a community-based, environmental education program organized around the urban watershed grew into a program on landscape literacy and community development. From 1996 to 2001, hundreds of children at Sulzberger and students at the University of Pennsylvania learned to read the neighborhood's landscape; they traced its past, deciphered its stories, and told their stories about its future, some of which were built. The tools they used were their own eyes and imagination, the place itself, and historical documents such as maps, photographs, newspaper articles, census tables, and redevelopment plans. The program had four parts: reading landscape, proposing landscape change, building landscape improvements, and documenting these proposals and accomplishments. The first two parts were incorporated into university and middle-school curricula during the academic year; all four were integrated in a four-week summer program.

I was warned that Sulzberger was shunned by many teachers in the Philadelphia School District; its reputation seemed to stem from the students' weak performance on standardized tests (among the worst of middle schools in the city) and by the fact that the neighborhood had a dangerous reputation. Like the residents of Mill Creek, all the students (and most teachers) were African American. At the start of the first year of the expanded program in fall 1996, a Sulzberger teacher told me that her students called their

neighborhood “The Bottom.” So they already know it’s in a floodplain? “No, they mean it’s at the bottom.” Both meanings of the word can be read in the area around the Sulzberger Middle School: standing water after rain; slumping streets and sidewalks; vacant house lots, rubble-strewn; whole square blocks of abandoned land, men standing around street corners on a workday afternoon, jobless.

To change the teachers’ and students’ perceptions that the Mill Creek landscape was divorced from the natural world was quite a challenge. It was equally hard to persuade students that the neighborhood had ever been different or that it might be changed. When my students spoke of designs for change, the children told them all the reasons the proposals would fail. “It won’t happen.” “Someone will wreck it.” Studying the history of the neighborhood proved to be the key that unlocked the students’ imagination.

“You mean, there really was a *creek*!?” a thirteen-year-old exclaimed in April 1997 as she examined a photograph from 1880 showing a stream, a mill, workmen dwarfed by the huge sewer they were building, and new rowhouses in the distance. The idea was to encourage the children to form the habit of looking for significant detail, framing questions, and reasoning out possible answers. The goal was that, after reading these documents describing the history of their neighborhood, the students would transfer this process to the reading of the landscape itself.

Landscape literacy entails more than reading, it means shaping landscape also. Each student made a proposal for how the creek might be transformed from a liability into a neighborhood asset. The essays and drawings were published at the end of the school year in a booklet with one-sentence reviews by the mayor of Philadelphia and city councilmen, among others.⁵ At the end of April, the Sulzberger students, together with their Penn mentors, gave a public presentation on the history of Mill Creek, illustrated with slides and posters, at a symposium held at the University of Pennsylvania.

At the beginning of the semester, Sulzberger students described their neighborhood in negative terms and said they would not live in Mill Creek if they had a choice. Only one student said she planned to attend college. Two months later, all but one student said they planned to attend college. The teacher reported that his students’ performance in all subjects had improved dramatically. He attributed this to the Mill Creek Project: to the way that primary materials challenged and made history real for the children and to their growing perception of how their own lives and landscape were related to the larger city, region, and nation.

From 1998, Sulzberger Middle School and the Mill Creek Project received increasing local, national, and international recognition. The Sulzberger portion of the West Philadelphia Landscape Project website led Pennsylvania’s governor to invite students from Sulzberger to make a five-minute presentation as part of his 1998 Budget Speech to the State Legislature. Later that year, the Philadelphia School District named Sulzberger “School of the Month” and produced a television documentary on the Mill Creek Project and the school’s innovations. In 1999 Sulzberger was the subject of a report on NBC Evening News, a national television program. In 2000, President Bill Clinton visited the school.

Recognition for the Mill Creek Project and for Sulzberger teachers and students opened doors to other collaborations. In 2001, the Philadelphia Water Department, Philadelphia Housing Authority, and the Philadelphia City Planning Commission submitted a proposal for \$34.8 million to the US Department of Housing and Urban Development’s Hope VI Program in order to redevelop Mill Creek Public Housing as a demonstration project that would provide an environmental study area for the school and integrate stormwater management measures to reduce combined sewer overflows. The proposal was successful, and the city cleared the site in November 2002 and broke ground in August 2003 on the project.

I was confident that things were going well for Mill Creek. Then the Commonwealth of Pennsylvania took control of the Philadelphia School District and granted responsibility for the management of Sulzberger, among other schools, to Edison, Inc., a corporation headquartered in New York. In 2004, I learned that the water department’s demonstration project in Mill Creek would not be built as envisioned. New houses would be built, but the program to integrate stormwater management to improve water quality was curtailed as was the collaboration with Sulzberger. Confronting these failures, I remembered the children’s initial skepticism about prospects for change: “It won’t happen....Someone will wreck it.”

Education, poverty, crime, transportation, housing: “There’s no money in America in the twenty-first century to deal with those things,” observed Howard Neukrug, who founded the Office of Watersheds in 1999 and was appointed Philadelphia Water Commissioner in 2011. “But, there is this money that we’re spending to improve the quality of water... For whatever reason, as a nation, we’ve prioritized combined sewer overflows.”⁶ With the US Environmental Protection Agency threatening to levy major fines on the city for polluting water, Neukrug persuaded the Philadelphia Water Department to

embark on a visionary plan for reducing combined sewer overflows using green infrastructure: *Green City, Clean Waters: Combined Sewer Long Term Control Plan Update* (2009). *Green City, Clean Waters* is now recognized as a national landmark of policy, planning, and engineering. It calls for reducing impervious surfaces in the city by 30 percent by 2020 in order to capture the first inch of rain to fall in a storm. If the plan works, it will save the city billions of dollars and has the potential to provide many other benefits, including jobs, education, and neighborhood development. But will it work (physically), and can it be done (economically, politically)?

To help test and refine Philadelphia's plan, in 2010 and 2011, my MIT students studied the ultra-urban Mill Creek Watershed from the headwaters of Mill Creek to its mouth and found that mistakes of the past persist even as this visionary plan is put forward. Ironically, over the past decade, the City of Philadelphia built new houses on former vacant land in the Mill Creek neighborhood, including many on the buried floodplain of Mill Creek. The strong pattern of vacant land on the buried floodplain is no longer as clear as it was, and the opportunities for addressing the city's combined sewer overflow problem there have been diminished.

Furthermore, few residents of the inner-city neighborhoods along the buried creek know about *Green City, Clean Waters*, and they lack the former Sulzberger students' landscape literacy. They do not read the intertwined stories their landscape tells of buried creek, undermined foundations, abandoned houses, vacant land, and community gardens. Without grasping those stories, it is difficult to envision how new landscapes might rebuild the neighborhood while purifying the city's water.

My students and I continue to investigate how *Green City Clean Waters* can promote the three E's of sustainable development. In fall 2015 and 2016, we worked on "From Green Schools to Neighborhood Transformation," a model program that integrates stormwater management and environmental restoration with neighborhood transformation and with education and empowerment of youth (<http://architecture.mit.edu/class/nature>).

Landscape Literacy, Environmental Justice, and City Planning and Design

Mill Creek is shaped by all the processes at work in inner-city America. The correlation of a buried creek with deteriorated buildings and vacant lands in inner-city neighborhoods is not unique to Philadelphia: similar situations are found in Boston, New York, St. Louis, and many other American cities (Spirn 1986 and 2000).

Twenty years ago, I thought that the worst effect of landscape illiteracy was to produce environmental injustice in the form of physical hazards to health and safety. The Sulzberger students showed me that there is an even greater injustice than inequitable exposure to harsh conditions: the internalization of shame for one's neighborhood. Before the students at Sulzberger Middle School learned to read their landscape more fully, they read it partially. Without an understanding of how the neighborhood came to be, many believed that the poor conditions were the fault of those who lived there, a product of either incompetence or lack of care. Learning that there were other reasons sparked a sense of relief. Once they had the knowledge and skill to read the landscape's history, they began to see their home in a more positive light. They came to consider the possibility of alternative futures and brimmed with ideas. Secure in their knowledge and their ability to reason, they challenged public officials with confidence and impressed them with articulate proposals. To read and shape landscape is to learn and teach: to know the world, to express ideas and to influence others.

Verbal literacy—the ability to read and write—is commonly acknowledged as an essential skill for the citizen to participate fully and effectively in a democratic society. Teaching literacy became a cornerstone of the American civil rights movement of the 1950s and 1960s. The "Citizenship School," which began as a means to increase voter registration through the promotion of literacy, evolved into a forum for discussion and catalyst for political action (Horton and Freire 1990). When, in 1999, I first read about Myles Horton's work with civil rights activists and Paolo Freire's with adult literacy programs in Brazil, I was struck by the many parallels to my experience with landscape literacy in Mill Creek.

Like verbal literacy, landscape literacy is a cultural practice that entails both understanding the world and transforming it. One difference between verbal literacy and landscape literacy, however, is that many professionals responsible for planning, designing, and building the city are not landscape literate. After six weeks' investigation into the history of their neighborhood, the children were more literate than many professionals, and some of their proposals for the neighborhood were more astute. To be literate is to recognize both the problems in a place and its resources, to understand how they came about, by what means they are sustained, and how they are related.

Landscape literacy should be a cornerstone of community development and of urban planning and design. To plan prudently is to transform problems into opportunities and liabilities into resources, and to

intervene at an appropriate scale. To design wisely is to read ongoing dialogues in a place, to distinguish enduring stories from ephemeral ones, and to imagine how to join the conversation. The stakes are high for those who must live in the places professionals help create. Like literacy, urban planning and design are cultural practices that can either serve to perpetuate the inequities of existing social structures or to enable and promote democratic change.

Notes

1. For nearly thirty years, I have asked my students (the majority are North American, with many others from South America, Asia, Europe, and the Middle East) for their personal definition of nature. Their responses have included the following. Nature was given as a trust to humans by God. Nature is trees and rocks, everything except humans and the things humans make. Nature is a place where one cannot see the hand of humans, a place to be alone. Nature consists of creative and life-sustaining processes which connect everything in the physical and biological worlds, including humans. Nature is a cultural construct with no meaning or existence outside human society. Nature is something that cannot be known. Nature is sacred. Nature is God.

2. Ecological democracy, as defined by Hester, combines participatory and ecological approaches to design with the goal of creating places that are memorable, healthy, equitable, and well adapted to their natural environment (Hester 2010).

3. The idea of landscape literacy builds upon, but is distinctly different from the idea of environmental legibility as developed by Kevin Lynch (1964 and 1981) and others. It also differs from ideas of environmental or ecological literacy (Orr 1992), primarily in its emphasis on human as well as natural history, on landscape language as a medium of action and expression, and its relevance to other issues beyond sustainability.

4. This chapter draws from twenty-seven years of fieldwork and of scholarly and participatory action research associated with the West Philadelphia Landscape Project, which I have directed since 1987. Sources include: historical documents such as census records, maps, plans, photographs, and newspaper articles; GIS maps, including the overlay of diverse data, such as topography, income, and vacant land; photographic documentation; interviews; direct observation. Given the scope of the project and the limited length of this essay, it is impossible to cite the diverse evidence and many sources for the arguments made here. More detailed citations will be documented in my book-in-progress, with the working title, *Top-Down/Bottom-Up: Restoring Nature, Rebuilding Community, Empowering Youth*.

5. *Power of Place: Essays about Our Mill Creek Neighborhood*. The texts and drawings of this report are on the WPLP website, as are the reflections of Sulzberger teacher Glen Campbell: <http://web.mit.edu/wplp/sms/pub.htm>. The name of the course was inspired by Dolores Hayden's book *Power of Place* (1995), which was required reading for the course.

6. Howard Neukrug, personal communication, August 8, 2012. See *Green City, Clean Waters* at www.wplp.net/stories. The Clean Water Act of 1972 (amended in 1977 and 1987) gave the US Environmental Protection Agency the power to enforce water quality standards.

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Biodiversity in an Urbanized World

Ahmed Djoghlaf

Feeding the ever growing world population, particularly in developing countries, in a more and more urbanized environment and a warmer planet is one of the most important challenges facing mankind. “Biodiversity is life. Biodiversity is our life,” this was the slogan of the worldwide celebration in 2010 of the International Year of Biodiversity.

Healthy ecosystems provide social, economic and ecological benefits as well as goods and services that underpin the world economy and, thereby, human well-being. However, according to the *Global Biodiversity Outlook* during the last decades human beings have changed ecosystems more rapidly and intensely than ever before in the history of humanity. Biodiversity is being lost at an unprecedented rate, thus threatening the very capacity of the ecosystems to continue providing their vital goods and services.

A recently released study reveals that during the last two decades our planet has lost 10 percent of its wilderness areas. Since 1990 more than 3 million square kilometers of wild areas, amounting roughly to the size of India, have been lost.

This is occurring despite the international community convened at the Rio Summit committing, through the adoption of legally binding international treaties such as the United Nations Convention on Biological Diversity, to conserve and sustainably use biodiversity.

Until recently 47 percent of the Earth’s surface was covered in forest. By now, however, forest cover has completely vanished in twenty-five countries, and only 10 percent remains in twenty-nine others. Every year 13 million hectares of forests continue to disappear, the equivalent to an area three times larger than Belgium. It is a well-established fact that tropical forests are the richest ecosystems in the planet in terms of biodiversity. Although they only represent 7 percent of the world’s surface, tropical forests currently house up to 80 percent of all identified living species. And yet, approximately 35 percent of all mangroves have been destroyed in the last years.

The extinction of animal and plant species is now between one hundred and one thousand times higher than the natural rate. As demonstrated by the Millennium Ecosystem Assessment, the pressures exerted on the planet’s natural functions by human activity have reached such destructive levels that the ecosystems’ ability to meet the needs of future generations is now seriously, and perhaps irretrievably, compromised.

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Scientists are of the view that humanity is in the midst of the sixth global mass extinction of species. For many biologists the fate of biological diversity for the next ten million years will almost certainly be determined during the next 50–100 years by the activities of a single species: *Homo sapiens*.

The accelerated urbanization of the developing world, particularly in Africa, compounded by the negative effects of climate change, is among the root causes of the accelerated loss of biodiversity we are experiencing.

Since 2007 the world has witnessed a paradigm shift. For the first time in the history of mankind the urban population has surpassed the rural population. Such an irreversible trend has ushered in a new age, “the *Homo urbanus* era.” The twenty-first century will be a century of cities. Such an unprecedented evolution will have far-reaching implications on the future of mankind and will shape modern society.

Urban population growth is one of the most dramatic recent changes affecting humanity. Two centuries ago only 3 percent of the world population lived in cities. Today, more than 50 percent does. Most of this growth is occurring in developing countries, which host the largest part of the planet’s biodiversity.

According to the United Nations Population Fund the world’s population will reach 9.2 billion in 2050, jumping by 2.2 billion people between now and then. Such an increase amounts to the total world population as recently back as 1950. During the last two centuries there has been a sevenfold upswing in the number of people living in the world. Such an expansion will continue to take place, mainly in developing countries in general, and in Africa in particular.

The thick of this surge will happen in cities. The urban population will increase by fifty million people every year, almost the entire population of Spain and Portugal combined. Over the three decades to come the urban population will grow by 1.1 million people every ten days.

In 1820, only three cities had a population of more than one million inhabitants—namely, Tokyo, Beijing and London. By 1900 that number had risen to sixteen, and by 1950 to fifty-four. Today more than 411 cities have a population in excess of one million people. Within two decades their number will rise to over one thousand. In 1950, only New York and Tokyo had a population of more than ten million inhabitants. Today there are more than twenty-two megacities—and all of them, with the

exception of New York and Tokyo, are located in developing countries.

In India, the urban population has multiplied by six since its independence in 1947. According to some estimates more than seven hundred million rural residents, the equivalent to the entire population of Europe, will migrate to Indian cities between now and 2050. Meanwhile, in China in 2000 there were 3.7 million villages. That number has shrunk since to 2.6 million. Indeed, three hundred villages disappear in the country every day. Yet over the course of the next decade China will build 50,000 new skyscrapers, the size of ten New Yorks.

Before 2025 another 221 cities will reach the one-million-people threshold. Europe, however, only has thirty-five such cities. Ninety-five percent of the world’s urban population will be found in developing countries. Every month the urban population of developing countries will grow by five million people, and by 2050 it will have doubled.

The African continent will witness the most dramatically accelerated urbanization process in the world. A report issued by UNICEF in August 2014 titled *Africa: Generation 2030* confirmed that the African population will continue to grow steadily until the end of the twenty-first century. In 1950 Africa represented 9 percent of the world population. In 2050 one quarter of all humanity will be African, and one child out of three will be African. The current African population is estimated to be 1.2 billion. It will reach 2.4 billion in 2050 and 4.2 billion by the end of this century.

Over the past half century Africa’s urban population has increased by a factor of eleven. In 1950, 14 percent of the African population was urban. Today 40 percent of the continent’s total population is found in cities and by 2050 that proportion will grow to 60 percent. Presently more than 350 million Africans live in urban areas. In 2050 their number will reach 1.2 billion people.

In 1950 not a single African city had a population of more than one million people. By 1960 only Johannesburg had broken through that threshold. Today the number has increased to more than forty. The population of Lagos in Nigeria is expected to double by 2030, reaching twenty-four million inhabitants, and the population of Cairo will reach twenty-five million.

The rate of urbanization in industrialized countries has reached 75 percent. However, these countries continue to lose large portions of their agricultural land, as well as their animal and vegetal diversity. The twenty-eight

countries that form the European Union are losing 1,000 square kilometers of fertile land every year. In France 60,000 hectares are lost owing to urbanization. In Austria, about 12 to 15 hectares of agricultural land are being erased from the map every day. Every day, Germany transforms about 110 to 120 hectares of land into streets, houses and other buildings. Meanwhile the need for agricultural soil is increasing due to the rising population, which is growing by about eighty-five million annually.

In 2050 more than 75 percent of the world population will live in cities. At the end of this century, 90 percent of the world population will be urban. Come 2030 four out of five urban citizens of the world will live in developing countries. Cities represent only 2 percent of the land of our planet but consume 75 percent of its resources and generate 80 percent of the CO₂ emitted in the world. Cities, however, have always shaped the world economy and influenced modern societies.

If mismanaged, the accelerated urbanization of developing countries may have a dramatic impact on the future of mankind. The lack of awareness by local leaders and policy makers in developing countries of the importance, value and services provided by nature counts among the major causes for this unprecedented loss of biodiversity. It is for this reason that the first of the twenty Aichi Targets contained in the 2011–2020 strategic plan for biodiversity adopted in 2010 by the international community is to ensure that “[b]y 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.”

Ill-conceived urbanization will greatly contribute to global warming. However sustainable and livable cities are part of the response to the challenges posed by climate change. The World Health Organization reports that in 2012 around seven million deaths, one in eight of total global fatalities, came as a result of air pollution exposure. This finding confirms that air pollution is now the world’s largest single environmental health risk. Reducing air pollution could save millions of lives. Trees not only provide oxygen, they also absorb air particles.

During the heat wave of the summer of 2003, which led to the death of more than twenty thousand people in France, the area of the Bois de Boulogne, owing to its vegetal cover, recorded temperatures three degrees centigrade lower than all other areas in Paris. It has been demonstrated that a vegetal cover of 10 percent can reduce the energy consumption of a city by 5 to 10 percent. It has also been demonstrated that cities with a large percentage of vegetal cover exhibit limited levels of violence. Furthermore, cities

with a large number of public spaces promote the creation of strong social ties among their inhabitants.

Scientists in Montreal have demonstrated that the risk of anxiety is 21 percent higher for urban citizens, who are subject to 39 percent more mood swings. Meanwhile the risk of developing schizophrenia is twice as large for people born in cities than for rural dwellers.

To accommodate the increased urbanization of the world, we would need to build a new city of more than one million inhabitants every week. It is the way these cities are conceived which will determine the future of mankind.

Urbanization is not the enemy of sustainable development. Cities are not the problem: they are part of the solution. The former mayor of Curitiba, Jaime Lerner, rightly stated, “Cities are not necessarily the problem. They are necessarily part of the solution.”

Cities are not the enemy of nature. Paris has more than 2,000 animal species and almost the same number of vegetal species. While biodiversity is diminishing in rural areas, it is increasing in Paris, which boasts 15 square meters of green areas per capita; London offers 45 square meters per capita and Brussels 59; Berlin is home to more than 8,000 wild boars and 2,000 foxes. The vegetal cover of Singapore is more than 16 percent of the surface of the state-city, which is emerging as a worldwide leader of urban ecology. Montreal has more than 1.2 million public trees; cities like Barcelona, Bilbao, Los Angeles, Miami and Philadelphia have successfully reinvented themselves.

However, the loss of biodiversity is not a necessary consequence of human activity, nor are cities unavoidably doomed to unsound urban management. Sound urbanization and environmentally well-managed cities can and do exist. Nevertheless, the cities at the forefront of the promotion of biodiversity in urban areas have a responsibility to share their experience with other cities in the world. Indeed, even if urbanization is irreversible, it is the way it unfolds which will determine the future of our species.

It was against this backdrop, and guided by the motto of the 1992 Rio Summit on Environment and Development, “think globally and act locally,” that I took the initiative, in my capacity as the executive secretary of the United Nations Convention on Biological Diversity, to convene in March 2007 in Curitiba, Brazil, a meeting on “Cities and Biodiversity: Achieving the 2010 Biodiversity Target.” The mayors of cities that have hosted meetings of the Conference of the Parties (COP) to the United Nations Convention on Biological Diversity as well as mayors of

cities hosting a United Nations chapter were invited to share experiences regarding the protection of biodiversity and discuss the various possibilities for cities to enhance their engagement towards the achievement of the three objectives of the convention. The Curitiba Declaration on Cities and Biodiversity was adopted by the representatives of the thirty-four cities which attended this meeting.

Parallel to the 9th meeting of the Conference of the Parties to the Convention on Biological Diversity, I convened in May 2008 in Bonn a meeting under the theme “Local Action for Biodiversity” to highlight the importance of urban biological diversity. The fifty mayors from thirty countries, representing over one hundred million urban dwellers, who attended this meeting adopted the “Bonn Call for Action on Biological Diversity.” This document was submitted to the high-level segment of the Conference of the Parties to the Convention, held with the participation of heads of state and government and more than one hundred ministers of the environment.

For the first time ever, for any United Nations environmental convention, cities spoke at the highest-level forum, thus setting a precedent for future meetings of the Conference of the Parties to the Convention and other related intergovernmental processes.

This initiative culminated with the convening of a city summit on biological diversity held in October 2010 in Nagoya, Japan in relation with the 10th Conference of the Parties. More than five hundred mayors and municipal leaders attended this meeting. For the first time a plan of action on sub-national governments, cities and other local authorities for biodiversity was adopted by the eighteen thousand participants representing the 183 parties to the convention. The objective of this plan is to:

a) Increase the engagement of sub-national governments and local authorities, in support of their parties, in the successful implementation of national biodiversity strategies and action plans, the Strategic Plan for Biodiversity 2011–2020, the 2020 target and the programs of work under the Convention on Biological Diversity.

b) Improve regional and global coordination and exchange of lessons learned between Parties to the Convention on Biological Diversity, regional and global organizations, United Nations and development agencies, academia, and donors on ways and means to encourage and support local authorities to manage biodiversity sustainably, provide ecosystem services to citizens and incorporate biodiversity concerns into urban planning and development.

c) Identify, enhance and disseminate policy tools, guidelines, and programs that facilitate local action on biodiversity and build the capacity of local authorities to support their national governments in implementing the Convention on Biological Diversity.

d) Develop awareness-raising programs on biodiversity for local residents (including major groups such as businesses, local administrators, non-governmental organizations, youth and indigenous and local communities) in line with communication, education and public awareness strategies.

As demonstrated by the Paris Summit, held with the participation of more than 150 heads of state and government, climate change is one of the most important challenges facing mankind. As stated by the secretary of state of the United State of America Mr. John Kerry in February 2014 while visiting Indonesia, “climate change is an arm of mass destruction.”

Indeed, climate change has been identified as one of the main drivers of the unprecedented loss of biodiversity. According to the Intergovernmental Panel on Climate Change (IPCC) up to 30 percent of all known species may disappear before the end of this century as a result of climate change.

However, green cities are part of the solution to climate changes. Green cities are ideal partners for the successful implementation of the historical Paris Agreement on climate change.

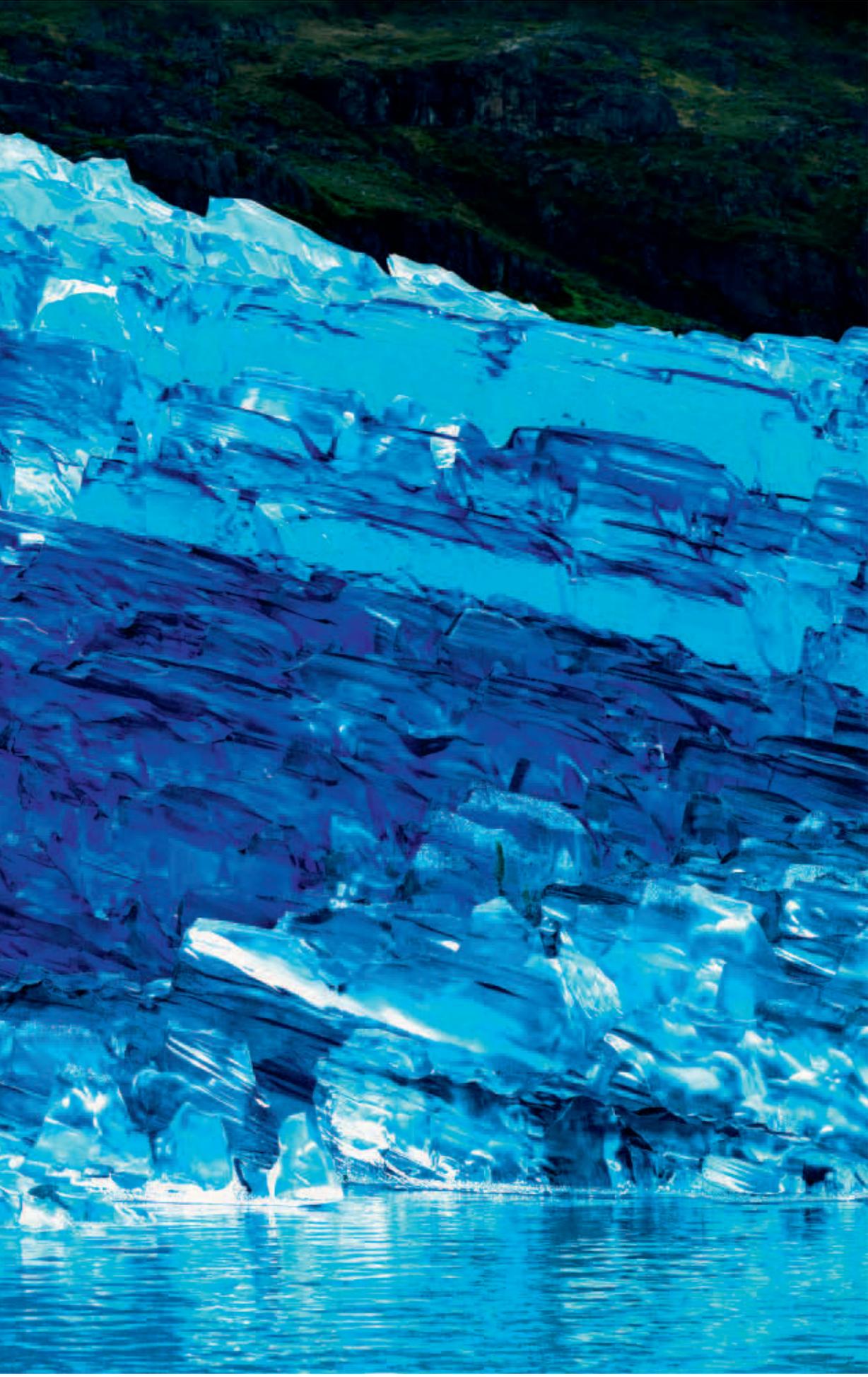
Therefore, if the establishment of the climate and cities program through the C40 and the designation by the secretary general of the United Nations Organization of a special representative on “cities and climate change” is a welcomed initiative, a similar program on cities and biodiversity is urgently required. The need to establish a permanent platform on cities and biodiversity with a view to promoting best practices, lessons learned and exchange of experiences in the context of both North–South and South–South cooperation is urgently needed.

Victor Hugo said, “The most powerful army in the world cannot stop an idea whose time has come.” The establishment of a permanent forum on cities and biodiversity is precisely such an idea, and its time has come.

Boomoon

The photographs of Boomoon (South Korea, 1955) show large extensions of sea, sky and land with no human presence or references whatsoever. Infinite, intact and static, nature reveals her unpredictability and immeasurable scope at the moment the image is captured. Those precise instants are, in Boomoon's words, "unconscious places," culminating moments in his relation with the world and the landscapes that make it up, which are dominated by order and chaos.





Untitled #8790, 2007 (Narsaq)





Untitled #7196, Breidamerkursandur, 2007





Skogar #384, 2015





Untitled #1361, Skeidararsandur, 2008





Urban poverty has a distinctive gendered dimension, as it puts a disproportionate burden on those members of communities and households responsible for unpaid care-work predominately women

Aisa Kirabo Kacyira

4.
*Dialogue
between Generations
and Gender*

With half of the world's population under twenty-five years and one third of it under fifteen, young people hold more power to our world's sustainable future than ever before

Siddharth Agarwal

Vernacular architecture has the potential to be an unlimited source of conceptual solutions through which sustainability can be rediscovered

Mariana Correia

The New Urban Agenda and the Role of Women in Cities

Aisa Kirabo Kacyira

Women and girls continue to face discrimination, poverty and violence within cities. Women in urban poor communities do not enjoy the same social and economic rights as men, including the right to adequate housing, clean water and sanitation. Urban women living in poverty often experience a higher degree of unemployment, as well as insecurity and vulnerability to violence, as they are more likely than women from higher income groups to become victims of violence both in the public space and within their own homes. Insensitive urban policies contribute to barriers that prevent women and girls from participation as both agents and beneficiaries of urban development.

Yet evidence shows that very few countries have ever achieved sustained economic growth, rapid social development and gender equality without urbanizing. Urbanization has been a powerful driving force behind profound social, cultural and political change, including important advances in gender equality. It has long been recognized that the greater cultural diversity found in urban areas can provide an enabling environment to deconstruct social norms, entrenched gender stereotypes and traditions or customs that hold women and girls back and perpetuate discrimination against them. Herein lies the gender equality potential of urbanization.

Women and Urbanization: Challenges and Opportunities

Cities are now the primary habitat of humanity. At present, 54 percent of the world's population resides in urban settlements; this is expected to rise to 66 percent by 2050 and surpass the six billion mark by 2045. At the same time, urban populations are becoming increasingly female and increasingly younger, with as much as 60 percent of urban dwellers expected to be under the age of eighteen by 2030. Cities represent an arena of challenges and opportunities for men and women with respect to access to essential services, access to social and economic rights such as education and health, as well as access to varied forms of livelihoods.

Yet cities are also home to deep inequality, marginalization, discrimination and despair. New migrants or even current residents can only afford to live in life-threatening sprawling slums and informal settlements. At present, 828 million people live in slums and informal settlements and the numbers continue to rise. These types of settlements are poorly connected to public transport and other essential services, such as clean water, sanitation and solid waste disposal. In these

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conditions life is dangerous and unhealthy, with constant barriers to a secure foothold in the urban economy. Furthermore, rapid urbanization is exerting pressure on freshwater supplies, sewage, the living environment and public health. In spite of accounting for only 3 percent of the world's surface, it is estimated that cities currently contribute between 37 and 49 percent of the world's total greenhouse gas emissions and it is projected that by 2050 cities will be responsible for more than 70 percent of global greenhouse gas emissions.

Child marriage is prevalent in urban areas. One in three girls in low- and middle-income countries (excluding China) will marry before the age of eighteen. One in nine girls will marry before their fifteenth birthday. In the least developed countries the prevalence of child marriage is even higher—nearly one in two. If present trends continue, the number of child marriages each year, 14.2 million in 2010, will be nearly 16.1 million by 2030. Despite national laws and international agreements, child marriage remains a real and present threat to the human rights, lives and health of children, especially girls, in more than a hundred countries.

Migration is also greatly affecting the rate at which urbanization grows and the shape it adopts. Between 2000 and 2015 the number of international migrants increased by 41 percent to reach 244 million. Almost half of them are women. So are half of the 19.6 million refugees worldwide. Addressing the unprecedented large movements of refugees and migrants requires a more humane and coordinated approach that all countries can endorse and implement.

The intersection between planned urbanization and migration can be further observed in conflicts, for example in Syria. So far, more than 100,000 people have been killed in the conflict. Cities and towns have been targeted, and hundreds of thousands of homes have been damaged or destroyed. As conditions continue to deteriorate, civilians are bearing the brunt of the violence. The Syrian conflict is primarily being fought in urban areas where 57 percent of the population lived prior to the conflict. Population density in urban areas is greatly increased by the massive inflows of internally displaced people (IDPs).

Another factor influencing urbanization is the age composition of the world population. This has changed dramatically in recent decades. Between 1950 and 2010, life expectancy worldwide rose from forty-six to sixty-eight years, and it is projected to increase to eighty-one by the end of the century. For the first time in human

history, in 2050, there will be more persons aged over sixty than children in the world.

Urbanization has the potential to be a powerful tool for achieving sustainable and inclusive development. About 6.25 billion people, 15% of them persons with disabilities, are predicted to be living in urban centers by 2050. The current lack of environmental accessibility faced by people with disabilities in particular in many cities in the world presents both a major challenge and a strategic opportunity for promoting equity and inclusion.

For women, gender discrimination magnifies and adds to the challenges and risks of cities. Why? Because gender inequality represents a structural discrimination and disadvantage that permeates every challenge, opportunity and space in cities.

The challenges cities face can be overcome in ways that allow them to continue to thrive and grow, while improving resource use and reducing inequality and poverty. Therefore, cities and human settlements can be safe, prosperous, equitable places to live. But this is impossible without the inclusion of every resident in their sustainable development. In this vein, all elements of urban governance and administration, urban legislation, urban finance, and urban planning need to actively embed gender equality measures. This is the position of the 2030 Agenda for Sustainable Development and the soon-to-be-adopted New Urban Agenda (NUA): inclusion makes for sustainable development.

A Personal Testimony

Having served as the mayor of Kigali, I have seen firsthand the positive power of urbanization. Today, Rwanda symbolizes the incredible resilience of the human spirit. When reflecting on the state of Rwanda in 1994, President Paul Kagame said, "Has there ever been a country more broken or more helpless?" It was deeply true, but cities are human constructs and can be planned and developed for the benefit of the entire population. For sure, it requires tireless efforts, hard choices, a visionary leadership, listening and responding to the needs of citizen and ensuring that they experience their own right to the city. These elements drove my work both as mayor and governor of Kigali Province. The benefits produced in Kigali have spilled over and transformed lives in peri-urban and rural areas too.

One of the challenges I faced as mayor was to harness the full potential of *all* the citizens, irrespective of income,

gender and age, and with particular attention to vulnerable groups. To do so, I launched initiatives actively involving each citizen in building their rights to the city. At a general level, I invested in infrastructure, in learning, in education, in skills development and a willingness to embrace change while remaining true to our heritage. Interventions were also launched to upgrade slums and low-income housing, improve garbage collection, ban plastics, improve public transport, and beautify streets and pavements. Community involvement was a key element of these efforts and promoting people's participation in the local city-planning decision-making process was a priority for me as mayor. For instance, through the *Umuganda* system local communities in Kigali gathered together on the last Saturday of the month and took part in unpaid communal work to improve life in the community.

At UN-Habitat I have consistently stressed that a gender-sensitive approach is extremely important to build a sustainable, prosperous and equitable city. Indeed, to do so, it needs to deal with the economic, educational and sociopolitical barriers that result in gender imbalances and gains only for a few. Women represent a disproportionate percentage of the urban poor, but at the same time, their contribution to economic development is tremendous. If women are empowered they become an extremely valuable resource for the development of their community. That is to say, that urban sustainable development can be fully achieved only if everyone strives to improve women's rights, promote equal participation in decision-making, and develop services that benefit women and men equally in all programs. Ensuring women's human rights in sustainable development means, among other things, ensuring equal access to education, work opportunities and financial services for women and men; integrating gender in laws and policies on land, housing and property rights; enhancing women's participation in decision-making processes through inclusive governance; and ensuring women enjoy a decent level of safety and security.

2030 Agenda and the New Urban Agenda

The 2030 Agenda for Sustainable Development, together with its Sustainable Development Goals, is a plan of action for people and the planet. Ultimately, it seeks to strengthen universal peace by addressing the root causes of poverty and adopting bold transformative steps to eradicate it, thus setting the world on a sustainable and resilient path.

This century will see a substantial majority of the world's population living in urban centers. At the recent Habitat III Conference, the New Urban Agenda was adopted—an action-oriented document which sets global standards of achievement in sustainable urban development, rethinking the way we build, manage, and live in cities by galvanizing action and cooperation among committed partners, relevant stakeholders, and urban actors at all levels of government as well as the private sector.

Today: Women in Cities

As mentioned earlier, urban populations are becoming increasingly female and increasingly younger. This is particularly evident among the urban poor. In fact, there is a clear hiatus between the contribution women make to the prosperity of cities—through their paid and unpaid labor—and the benefits they derive from it in terms of representation in urban governance, equal access to livelihoods and equal access to public space.

Urban poverty is strikingly different from rural poverty, since urban economies are heavily associated with the secondary and tertiary sectors and therefore more dependent on cash incomes to meet essential needs. As a result urban poverty has a distinctive gendered dimension, as it puts a disproportionate burden on those members of communities and households responsible for unpaid care-work—predominately women. In addition, cash-based urban economies mean that poor women are compelled, often from a very young age, to also engage in paid activities, while at the same time undertaking unpaid care-work. Consequently, combined with unequal rights to adequate housing, to minimum economic welfare, to voting and to freedom of movement in public spaces, efforts to balance paid work and unpaid care-work take a particular toll on women, and in some case, even girls.

It is widely recognized that urban women are at greater risk of being victims of violence than rural women. While gender-based violence is largely determined by gender inequalities and cultural notions of femininity and masculinity, it is also significantly linked to inadequate basic infrastructure and access to services, which increase women's vulnerability.

In sum, while the world's cities are increasingly accommodating more women than men, there is a wide set of factors that hold women back as integral drivers of sustainable urban development, including their unequal position in the labor market, their limited ability to

secure assets independently from male relatives, and their greater exposure to violence. Therefore gender equality policies and solutions must be integral to bringing women on-board as equal partners and assets in seeking participatory methods to enhance the sustainability and quality of life for all urban residents.

Message for the Future

Women and girls currently face a myriad of challenges in urban environments, but the future is not all bleak. There has been significant progress made in gender equality across the world. Today, women have better access to basic services, improved participation in governance and more knowledge of their rights than ever before. Although urbanization presents new challenges, it also creates new opportunities. Urban women are less subjected to discriminatory and dangerous traditional practices, have more ability to participate in the economy and are less reliant on marriage and men for their health and safety. We must not give up the continuing fight for equality, but it is also important to acknowledge the progress made in a relatively short period of time.

I envisage a future, perhaps in twenty years, but more likely in fifty, where women, girls, men and boys will have the same opportunities throughout their lives. Women and girls will have equal access to education, to job opportunities, to control of their own bodies and lives and to representation in government and business. Urban centers can drive these changes, through cultural changes, innovation and education. Cities can become the beacon of hope for women, as long as we keep gender equality and urbanization high on the global agenda.

* * *

Women across the world are finding themselves in new and challenging situations. Many of their challenges are unique and different, but there are common themes. Female MPs and CEOs in London face gender-based discrimination, just as a woman selling food in the slums of Nairobi does. Women are now landowners, doctors, heads of households, migrants, ethnic minorities, lawyers and people living with disabilities. All of these groups face difficulties in gaining equal opportunity. The global spread of urbanization presents an exciting opportunity to change traditional gender roles and create opportunities for women. But in order to achieve this, we must continue to put gender equality high on the agenda. The world has never seen such rapid urbanization and such a major shift in the way human beings are living.

Nor have we ever seen such a major cultural shift and break with tradition. These two phenomena must be harnessed and shaped to create a society that gives equal opportunity to all.

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Youth and Poverty in the Population

Siddharth Agarwal

The Role of Slum Children and Youth toward a Better Future in an Urbanizing World

The United Nations 2030 Agenda for Sustainable Development, along with a set of seventeen bold new Sustainable Development Goals (SDGs) adopted by member nations during the General Assembly held in New York on September 2015, outlines specific focal areas for improving the status of vulnerable and impoverished populations. This is reflected by the emphasis of many of the seventeen SDG targets on achieving inclusive development, among them target eleven, which aims to make “cities and human settlements inclusive, safe, resilient and sustainable.”

With over half of the world’s population under twenty-five years of age and one third of it under the age of fifteen, young people hold more keys and more power to our world’s sustainable future than ever before. While a substantial proportion of urban youth is benefiting from the technology available and using different media to connect with other young people across countries and continents, there is a large number of young people and children living in slums, informal settlements and similarly disadvantaged environments in the global south. According to the United Nations about 1.8 billion people out of a world population of 7.3 billion are aged between ten and twenty-four years old (Das Gupta et al. 2014). That is up from 721 million people in 1950, when the world’s population totaled 2.5 billion. Never before have there been so many young people globally, many of them living in developing countries. In fact, in the world’s forty-eight least developed countries, children and adolescents make up the majority of the population.

Rapid urbanization is another defining feature of today’s world, with nearly 55 percent of the global population being urban in 2016. But fast-paced urban growth places tremendous strain on housing and serviced land. By 2030, about three billion people, roughly 40 percent of the world’s population, are expected to need proper housing and access to basic infrastructure and services such as water and sanitation systems. This translates into the need to complete 96,150 housing units per day with serviced and documented land from now till 2030.

Deprivations and Challenges

The Global Report on Urban Health: Equitable, Healthier Cities for Sustainable Development, published in 2016 by the World Health Organization, states that the top six hundred cities, which account for one fifth of the world’s

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population, produce 60 percent of the global GDP (WHO 2016). At the same time, unplanned and unmanaged urbanization has led to increased inequality, the growth of slums and disastrous impacts on efforts towards sustainable development in today and tomorrow's fast-growing cities. The urban youth population is steadily increasing, as is the proportion of this segment which is presented with lesser opportunities to contribute as citizens, as compared to children born into families with more resources, who therefore have better access to education and other opportunities. This unequal access to basic services along with extreme poverty, sub-optimal physical living environments, weak access to government entitlements and social benefits, discrimination, and lack of information hinder the potential of slum youth. Furthermore, slums and informal settlements, and consequently slum youth, are often considered illegal even in countries where constitutionally there is no concept of illegality of human beings.

According to UN-Habitat, 85 percent of the world's young people live in developing countries, where they often comprise a large portion of their communities (UN-Habitat 2015). An increasing number of young people around the world are growing up in cities—especially in the fast-growing cities of sub-Saharan Africa, Asia and Latin America. In many cities across the African continent, more than 70 percent of the population is under the age of thirty. Yet these young people have few resources available to improve their own living environment. Today's rapidly urbanizing world is full of social, environmental and economic inequalities which present important challenges for political and economic forces. Slum populations are facing spatial injustice across countries in Asia, Africa and Latin America in particular, but also, to a lesser extent, in the Western world. Space in urban areas is becoming increasingly less accessible to those living in slums and other marginalized sections of cities. Youth, children and women use public spaces the most, be it for recreational purposes, such as playing games and sports, small neighborhood businesses or transportation. It is unfortunate that for urban slum communities and other similarly marginalized groups urban space is becoming increasingly less accessible. In emerging economies, such as the BRICS nations and other countries that are catching up, slum children and youth remain largely excluded from the benefits of economic progress that come with urbanization. Owing to a series of factors, including the lack of exposure to career avenues and low levels of encouragement from parents, schools or other sources, slum youth and children often opt out of their

aspirations and fail to pursue paths that could fructify their potential. UN-Habitat estimates that young persons make up 25 percent of the global working age population, but account for 43.7 percent of the unemployed. This means that almost every other jobless person in the world is between the ages of fifteen and twenty-four.

A World of Opportunities

Provided deliberate efforts are made to invest in their education and present them with better opportunities, these young people with tremendous energy and enthusiasm can not only build their lives as productive social beings, they can also contribute to their countries' development and positive transformation.

It is crucial to nurture and stimulate the potential of urban disadvantaged youth in order to achieve equitable opportunities in an urbanizing world, particularly in low- and middle-income countries. The way governments, civil society and other stakeholders work to cultivate and nourish the aspirations of this segment of the young population and to address their needs will define our common future and the path towards sustainability. This segment represents a huge source of potential living in underprivileged communities whose contribution is as important as that of more fortunate young populations. There is a need to expedite the provision of opportunities towards socioeconomic development to slum children and youth as a means towards socially equitable society. There is vast potential in the large numbers of young people who are yet to gain education and training, and who can subsequently be employed as skilled, semi-skilled or highly skilled workers in various sectors, from the service industry to information technology or manufacturing, contributing to the economic growth of the increasingly urbanized economies of developing countries.

Actual Experience

Constructive efforts being undertaken in Spain to include marginalized and excluded groups in public space and to democratize urban planning have delivered promising results. *ArchDaily* explains that Factoria Joven (youth factory), located in Merida, Spain, is a youth-inspired built space created from recycled materials. It holds a skate park and offers resources that empower and encourage young people to participate in public space and community-building. The concept was first

This segment represents a huge source of potential living in underprivileged communities whose contribution is as important as that of more fortunate young populations

introduced in 2006 by Carlos Javier Rodríguez Jiménez, a physical education teacher who studied the humanization of urban spaces, and four collaborators. Architects José Selgas and Lucía Cano were inspired by the forms and construction of Chinese dragons, and singled out inexpensive building materials for the project, including lightweight polycarbonate. In addition to outdoor sporting activities, art events and theatre, the building houses a computer lab and a dance studio, meeting rooms and spaces used for street theater, video projections and electronic music. A piece in the online magazine *Architectism* gives credit to the youth factory for attracting restless kids from the streets and providing them with a place to cycle, skateboard, dance, climb rocks, create graffiti—activities they would otherwise have to do in much more sinister surroundings (Architectism 2015). This demonstrates the need for public space, but also the resilience, creative energy, and perseverance of slum youth to create such space.

In Kenya, the Mathare Environmental Conservation Youth Group (MECYG), a social enterprise run by young people, undertook community cleanups and established a garbage collection service in Mlango Kubwa, a community that houses about forty thousand dwellers and which had never had a similar service in the past. In 1997 MECYG gathered resources to build a youth center and a soccer field. The youth of Mlango Kubwa have responded by using the soccer field and community center every day, while violence in the area has diminished and most residents are happier and more positive.

Mlango Kubwa lies on the periphery of Mathare, one of Nairobi's biggest slum clusters. Like in most slums, young people in Mathare face many challenges, from access to safe spaces to access to resources and opportunities. What distinguishes them from others, though, is their drive, enthusiasm and willingness to strive for change. They take no chances and work together to make their community a better place for all, but especially for the children and young people. This initiative highlights how the indomitable spirit of the Mathare community, and the desire, potential and talent of its youth inspired them to pursue sustainable urban development efforts that have created lasting positive changes for all residents.

In India, They Take Charge of Wellbeing Processes

“Resolve, Zest and Flight” is a slum youth stimulation initiative implemented by impoverished children across

underprivileged communities in and around the cities of Indore and Agra in India. Approximately 100,000 people live in these communities and have access to the initiative organized by the Indian non-profit entity Urban Health Resource Centre (UHRC). The approach involves encouraging the formation of children and youth groups in slums, mentored by slum women's groups and UHRC's social facilitators. The focal point of UHRC's efforts is stimulation, motivation and capacity building.

Thirty children and youth groups with 450 members are active in the slums of Agra and Indore. Child and youth development is fostered through avenues for self-expression, team-work, excelling in performance, reasoning with self and cultivating positive self-image. The result is that communication and leadership skills are honed.

UHRC's program facilitates the creation and use of platforms where youth and children can express themselves through oral and written communication, reciting poems and singing songs on themes such as determination and courage, which further contribute to increase their self-confidence. They have also staged street plays on preventing infections, the ill effects of alcoholism and other socially important themes, including performing outside their city in Mumbai, which lends added self-worth and confidence. Pursuing activities that they enjoy and gain knowledge and skills from also reinforces their growing self-confidence, as noted in earlier works (Payne 2008). These platforms are analogous to the concept of place, which "does not refer simply to a geographic location but also to the opportunities that are available to create meaning within a place" (Wilson 1997). Opportunities-based pedagogies as implemented by this program are effective in furthering learning and imparting knowledge and skills "which have some direct bearing on the well-being of the social and ecological places people actually inhabit" (Gruenewald 2003). The outcome of enhanced self-esteem and improved self-image among children and youth reinforces self-confidence in their own abilities. Reasoning with oneself during planning and action sessions develops thinking skills (Hwang and Nilsson 2003). Social interaction with peers and elders, women's group members, volunteers from different walks of life, elected municipal representatives, and the education system helps young people to free themselves from difficult situations, focus towards the future, and acquire the ability to influence it (Vygotsky 1978).

A central tenet of this program is that the slum children and youth groups mentored by the slum women's groups

of the Urban Health Resource Centre should guide the design and implementation of the very program. As a proactive measure to foster gender equality every group has two leaders: one boy and one girl. Each group usually has between ten and twenty members. Every member must save a small amount, which is determined by the slum youth themselves and can vary from five to fifty Indian rupees. Collective saving and the use of resources to help prevent interruptions in their education and to organize activities such as sports days enable the children and youth to learn the importance of regular saving and of collective efforts.

Slum children and youth group members identify opportunity gaps, instances of inadequate stimulation, aspirations, ways to strengthen as groups, contribute to the progressive evolution of the program, and facilitate the creation of children and youth groups in neighboring slums. This program has been developing brick by brick over five years, with slum youth and children playing the role of experts and contributing to the continuous improvement of the approaches over time. Children and young people are motivated to give careful thought to certain key questions: "How can we collectively move towards addressing a given problem;" "how can we find more details on how to act to solve a problem;" "which aspects can be tackled by our own collective efforts and for which parts of the problem do we need to contact the authorities?" A similar approach to stimulate and develop thinking skills among children and youth has been stressed in earlier works (Devereux 2002).

Slum youth and children groups complement the efforts of slum women's groups in identifying and implementing solutions to the challenges faced. They write collective petitions to municipal corporations for the garbage to be cleared and the drains to be cleaned; they fill up individual applications for income certificates and present them to the relevant local ward-level elected representatives and district offices in order to obtain the documents that make them eligible for the government's education scholarship. Slum children and youth groups, supported by women's groups in their neighborhood, promote the education of young girls and women, and could be central in efforts to reduce the gender inequality prevalent in the male-dominated society they are part of.

Education is emerging as an embodiment of inclusion, as knowledge about the risks of exclusion becomes widespread. Indeed, education is playing an important role in gradually, gently changing the long-standing social norms that perpetuate and reinforce social inequalities. An increasing number of the young are

The unequivocal and harsh reality that all corporate bosses, political leaders, administrators and all segments of reasonably affluent dwellers need to accept is that without slums, the hardware, multi-sector services of urban spaces will break down miserably

completing school education, and therefore complementing their family income; the social impact through improved gender sensitivity is visible; and other benefits of the program include improved hygiene and living environments. These outcomes are the result of practicing thought and encouraging reasoning and logical thinking. Recently, the need for computer literacy has become evident, as a means to make the most of access to the Internet and other digital tools. The development of these skills will help underprivileged communities access government schemes and services online, thereby reducing access costs.

These actual experiences confirm that when presented with options and opportunities all human beings, including slum children and youth, would willingly engage in activities that they recognize as beneficial to their self-development and/or empowering when it comes to facing the challenges that will allow them to positively transform their lives. The program also enables them to build greater recognition in their schools and in their communities, which acts as an additional motivating factor for them to persevere with program efforts. Children and youth progressively strengthen their faith in their growing ability to improve their future and that of their neighborhood. Self-confidence, social interaction with peers and persons external to their social milieu, and the development of collaborative skills and leadership all contribute towards self-improvement.

What Is Crucial to Pursue

Our image of shanty towns results from what we observe as we drive past slums while comfortably ensconced in the temperature-regulated interior of our cars. However, slum populations contribute significantly to maintaining city life. The unequivocal and harsh reality that all corporate bosses, political leaders, administrators and all segments of reasonably affluent dwellers need to accept is that without slums, the hardware, multi-sector services of urban spaces will break down miserably.

Lack of youth empowerment can lead to tokenism. Hence it is critical that inclusive efforts are implemented with the sincerity necessary to ensure that marginalized groups are encompassed in their scope such that they can have their say and contribute to society in equitable and meaningful ways. Following years of intense lobbying and stressful negotiations, UN secretary general Ban Ki-moon declared that these new sustainable development goals are “the people’s agenda” (Ki-moon 2016). While

this gives hope, in order to achieve any sort of progress on the people's agenda the people themselves must be equipped to lead the process of change.

A coordinated effort by government agencies, civil society organizations, associations of slum youth and adults, and socially sensitive citizens holds the potential of improving physical and social living conditions on the ground, enhancing education and skills building, promoting hygiene and sanitation behaviors, and fostering enhanced value in the role of women and girls in their communities. This would go a long way toward nurturing slum youth and preparing them for greater responsibilities. Additionally, senior youths can mentor and enhance the education and confidence-building experiences of younger youths and children in slums.

It is my hope that when senior officials of different United Nations agencies, country government politicians, bureaucrats and others in positions of authority participate in high-level UN and other global, regional and national meetings, they spend at least eight to ten hours in slums at the location of the meeting. This will enable decision-makers to learn of solutions from the real experts: the local slum residents, including energetic children and youth who live their challenging life 24/7, 365 days of the year. This way, the resolutions and guidelines for nations, ministries and administrative entities crafted by them would certainly be more realistic (even if they might seem difficult).

Facilitating ownership among young people from slums and their families is critical, instead of the tokenistic "participation"—a word that for decades has been used to pass off strategies as being pro-poor or being sensitive towards marginalized people. When slum youth and other similarly disadvantaged groups take charge of the processes, that shifts the balance of power towards more accountable governance in our fast-growing cities, as well as in rural areas. This can also get real action to actually be implemented in the interest of the marginalized, including women, girls, youth and children. The time is now to democratize urban development and create space for marginalized populations, especially youth, to contribute their ideas in ways that can produce lasting sustainable impact.

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Experiences from the Past for Today's Challenges

Mariana Correia

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During the twentieth century technological development and the increase of mass production led to a progressive abandonment of traditional building techniques and ways of life, especially in urbanized regions pressured by rapid and unrestrained growth. From the seven billion people that today inhabit the planet, the United Nations Human Settlements Programme estimates that four billion live in informal houses, from which one billion of urban poor live in slums (UN-Habitat 2006). According to UN-Habitat, a slum is an urban area with a lack of basic services (sanitation, potable water, and electricity), substandard housing, overcrowding, unhealthy and hazardous locations, insecure tenure and social exclusion (UN-Habitat 2003). In a short time period, several communities around the globe felt pressured to move from rural regions to urban areas located in the outskirts of cities. In these urban substandard areas, rapidly growing to become part of megacities, construction is developed using all sorts of materials and building possibilities, following neither standard regulations, nor the building-culture intelligence encompassed in vernacular construction.

Meanwhile, the 3.1 billion people that live in rural areas (United Nations 2014), mostly have no access to Internet (ICT 2015), and a great number still lead traditional ways of life, with long-established customs and beliefs that have passed from one generation to another. In these communities, vernacular architecture expresses their adaptation to climatic and landscape contexts, the use of local natural materials, and the embodiment of their empirical knowledge regarding construction know-how (Correia 2009).

Vernacular Architecture

Thus, what is vernacular architecture and why is it relevant? According to Rapoport, the term refers to specific dwellings built in a certain geographical context, responding to the physical and cultural environment that surrounds it (Rapoport 1972). Rudofsky calls vernacular the architecture without architects that is anonymous, spontaneous, indigenous, or rural (Rudofsky 1990). For the *Encyclopedia of Vernacular Architecture of the World*, Oliver defines vernacular architecture as all the dwellings and buildings, either private or community-owned, which were built using traditional technologies (Oliver 1997). The *Oxford Dictionary* (2016) defines vernacular architecture as that which concerns domestic and functional rather than

public or monumental buildings. Its designation and conceptual development is also discussed in “Vernacular Architecture?” (Carlos et al. 2015). Hence, vernacular architecture can clearly have different approaches, interpretations and meanings. The operational definition for this framework will be the architecture that has no formal planning, but holds an intrinsic built-in intelligent culture.

Nowadays, vernacular architecture is considered by many in the Western world as a heritage to study, conserve and value, an “old” form of traditional architecture, part of a region’s identity. Many others, mostly in rural areas of the undeveloped world, live with vernacular architecture on a daily basis, as traditional building systems are still employed in day-to-day life, using the resources available in their immediate surroundings and the know-how associated with local building culture. Using stone, earth and wood, bamboo or reeds remains a common and intelligent way of building in harmony with the context. Several communities continue to build in the same way as their ancestors used to, putting to use the local know-how and building culture passed to them from generation to generation.

Given the balance between energy saving, tradition, environment, and social commitment it can boast, vernacular architecture has the potential to be an unlimited source of conceptual solutions through which sustainability can be rediscovered. The project *VerSus: Lessons from Vernacular Heritage to Sustainable Architecture*, coordinated by Escola Superior Gallaecia with the cooperation of its European partners (Correia, Dipasquale and Mecca 2014), entailed the identification of the principles embodied in vernacular knowledge, which are nowadays being applied throughout the world in various efforts concerning traditional and contemporary sustainable development.

Community Engagement

Furthermore, in vernacular architecture, know-how can only be transferred if the community is still empowered to optimize the use of local intangible resources, contributing towards the development of effective strategies for sustainable development. Thus, community engagement has contributed to integrate people in society, to support traditional ways of life, and to keep social cohesion. This has been possible through balanced efforts directed to a more inclusive

enhancement of the communities’ approach toward sustainable development.

What can be observed around the world is an upsurge in the value ascribed to community engagement and capacity building, as they could have a positive impact on the transfer of local know-how and of intangible knowledge. For instance, in Mali, local communities use self-organized craftsmanship associations to transfer their know-how, encouraging traditional values and respect for the empirical knowledge of the older generation. This is evidenced for instance, in the annual festival carried out at Djenné Mosque, a renowned World Heritage site in Mali. The entire community gets together to participate in the ritual celebration of the mosque’s maintenance, climbing the built-in scaffolding to apply the traditional earthen plaster. Also in Nicaragua, communities of workingwomen play a leading role in developing capacity-building skills among the younger generations, as all over the country inspiring women committed to their communities impart training on traditional building techniques to young unemployed people. By developing their building skills they give them the chance to live an independent yet integrated life.

Nowadays, community engagement is therefore most relevant, as it promotes the integration of people in society, supports traditional ways of life, and maintains social cohesion, reinforcing sustained local values in communities and emphasizing a sense of belonging. Engagement in communities becomes essential and connects populations socially and culturally.

Collective Values

Several communities worldwide have created sustainable systems for local development. They aim to promote an efficient and affordable use of local resources, techniques, and goods, sharing the know-how of the different individuals within the community in order to enhance their collective values.

To survive harsh environments, isolated communities look for efficient ways to manage their few resources, mainly by communal systems. This is evident, for instance, in desert climates, where systems are devised to collect, distribute, and use water in an efficient way. Underground tunnels created by men carry water over long distances in the desert, reaching the soil on the surface and creating oases for populations to settle. These hydraulic systems supply drinking water, as well

Architecture should be with the people and for the people and should genuinely contribute to the improvement of society and the quality of people's lives

as irrigation for agriculture. They are used across the Mediterranean region and Middle East, and are known as *qanat* in Iran; *falaj* in the United Arab Emirates; *khattara* in Morocco; or *foggara* in Algeria. This collective use of water is only possible through community values shared by people who live in very dry climate regions.

This sense of community self-help, currently at work in different regions of the world, is also evident in the collective construction of houses or rural facilities in isolated regions. This system is known in South America as *minga*, and it brings together neighbors from the same community on the basis of mutual aid to build dwellings. *Minga* is mainly used in rural areas and its practice is observed at least in Argentina, Chile, Ecuador, and Paraguay, though it is also stipulated in other Latin countries, as revealed in the publication *Earthen Architecture in Latin America* (Correia et al. 2016).

Local Knowledge

Working on heritage implies valuing local and traditional knowledge, which for thousands of years was key to fulfill humanity's housing needs. Nowadays, heritage conservation also demands the preservation of craftsmanship skills. Viewed as a resourceful database of local building culture, this know-how is becoming widely respected, as it is now considered part of the knowledge required for the maintenance of monuments, but also of vernacular heritage. In Japan, keeping alive traditional craftsmanship skills is a way of preserving the authenticity and integrity of their principles, especially among the most holly Shinto shrines and Buddhist temples classified as World Heritage sites.

Local know-how associated to intangible heritage is essential—the cornerstone, even—for conservation in contexts where social and cultural cohesion are at the core of local sustainability. Safeguarding cultural heritage as well as the knowledge of intangible resources through capacity building therefore constitutes a fundamental contribution for cultural diversity and human sustainable development.

Establishing relations that value the development of strategies to enhance local knowledge in different communities takes time. One way of creating such relations, for instance, is through workshops. However, if the same workshop content is developed recurrently in many different places then its impact will be the exact opposite. The main goal should be to identify the know-how

of local building cultures, in order to establish strategies to enhance them and value their conservation. Rediscovering their building tradition highlights the importance of communities and their heritage, and thus contributes to the local economy. This in turn helps to place value on the identity of the community and its sustainable development. It could also improve the social stability of the community and create the conditions for a more balanced approach toward the preservation of heritage, as recommended by the international conservation charters and guidelines.

Life Cycle of Buildings

With the current emphasis on high-performance construction, why is know-how of local building culture important?

The building sector plays a key role in the consumption of energy and resources in the world, as well as in the production of waste. According to UNEP-SBCI, it is estimated that at present buildings contribute as much as one third of the total global greenhouse gas emissions (UNEP-SBCI 2009). This is mainly due to the use of fossil fuels in their operational phase. However, the three phases of energy consumption in the lifespan of a building should be considered (Evangelinos and Zacharopoulos 2013). The first phase is the *manufacturing-construction period*: materials are extracted from the natural environment, processed or manufactured (*embodied energy* relates to the production of the material; *grey energy* relates to the transport of the material; and *induced energy* relates to the energy needed for the construction of the building). The second phase is the *useful life of the building*, which relates to the energy needed for its maintenance (*operating energy* required for the *building* during its lifespan). Finally, the third and last phase is the building's post-life period (the energy needed for the *demolition* of the building, *recycling* of the material, and the *reuse* of any relevant component).

One of the key factors behind the present interest in traditional building techniques and local know-how relates to the savings derived from the use of natural, ecological and sustainable materials rather than excessively processed ones. Furthermore, this type of traditional building exacts far lower levels of energy consumption. Earthen architecture, for instance, so much in fashion over the last decade, provides a perfect example of this situation: embodied, grey and induced

energy requirements are reduced to a minimum; the material is available onsite, so no energy is consumed in processing or transporting it; and energy consumption requirements for its construction are minimal. Also, the operating energy required for the maintenance of the building can also be reduced if bioclimatic features are considered in the building's design, for instance, through the incorporation of heating and cooling systems to the passive design. Furthermore, the use of natural building materials reduces the chemical impact on the inhabitants, which contributes to a better quality of life. Finally, the post-life building phase has an enormous potential, as the material can be recycled and reused in construction.

The Focus on Education

Students of architecture, engineering, planning, and conservation must be trained to value and enhance the local buildings cultures still prevalent around the world. In most architecture and engineering faculties students are taught about modern materials and contemporary building systems. Most of the time these university students are not sufficiently capacitated to understand and value traditional building knowledge, even if a great part of the world's built heritage has been constructed using local building cultures. As a result, and following the lessons they have been imparted, a good number of architects and engineers engaged in heritage intervention opt to remove parts of the building's interior and replace them with new materials and contemporary building systems. Indeed, at times the scope of the "rehabilitation" is overstretched and interpreted as an actual "reconstruction," with new materials and spatial typology.

But new contemporary architecture and heritage intervention could also incorporate community values and ascribe significance to knowledge of building traditions. In this regard, curricula of schools and faculties of architecture, engineering, urban design, planning and conservation should play a key role in valuing and enhancing traditional building systems, local knowledge and the uniqueness of the vernacular architecture of the different countries. Architecture should be with the people and for the people and should genuinely contribute to the improvement of society and the quality of people's lives.

Much of the world's expected future urban growth will take place in developing countries. As a result, these

The use of natural, ecologic and sustainable materials, traditional building techniques and local know-how exact far lower levels of energy consumption

countries will face numerous challenges in meeting the needs of their growing urban populations (United Nations 2014). One way to balance this huge influx will be to value the knowledge held by traditional communities. Preserving and understanding human and social systems can have a major impact on the quality of life of the different communities. Considering the great diversity found in local vernacular architecture, a single and conventional international architecture will not adequately respond to all the intrinsically unique contexts of the world. Respect for diversity and empirical knowledge with critical thinking can contribute to look at each context with a distinctly creative and intelligent approach. Relying on local knowledge gives communities a chance to take part in a more balanced and ethical sustainable development.

If know-how of local building culture is integrated in this new contemporary and participatory architecture, then the relevance of the social contribution made by all parties involved becomes a crucial aspect of quality building, which therefore also contributes to the sustainable development of communities.

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It is no longer sufficient to lay the blame on politicians. It becomes the responsibility of citizens to demand but especially to work toward the improvement of their quality of life and that of the people and the society around them. As architects, engineers, planners, conservators, builders, artists, teachers, researchers, parents, citizens, we have a responsibility to identify the priorities and criteria that make the transfer of knowledge and know-how possible, significantly boosting local communities; develop skills to integrate local knowledge into projects, ensuring that they are in tune with their environment and social community; engage with isolated and segregated communities to incorporate them into society in an open, balanced and respectful way, because no culture should dominate over other cultures; and finally, contribute toward the creation of a more socially responsible world.

We must all take more action and contribute toward sustainable development, community engagement, capacity building, and valuing of local knowledge with social responsibility. This can be achieved if we move beyond our comfort zones, and endorse personal engagement, ethical work and responsible teamwork.

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Lime Hills

Naoya Hatakeyama

With exhaustive work over many decades, Naoya Hatakeyama (Japan, 1958) has described the transformation of limestone quarries into sophisticated cities. Although these landscapes transmit a great sense of stillness, there is a constant and unstoppable movement inside them. Hatakeyama thus offers a subtle meditation on mankind's impact on nature, which we mold, dominate and ceaselessly consume.





































We shape our future
through the things in
which we invest. The
kinds of investments that
took us to where we are
now won't take us to
where we need to get,
so we urgently need to
change the mix

Mike Berners-Lee

5. *How We Finance the Transition*

Existing initiatives from around the globe prove that sustainable procurement transforms markets, boosts environmentally friendly industries, saves money, conserves natural resources and fosters job creation

Arab Hoballah

The notion of “net-positive” propositions and approaches to building design practice has now emerged wherein some buildings may offer the potential of collecting more energy and water than they need to support their requirements

Raymond J. Cole

Disinvestment, Investment, Subsidies and Tax

Mike Berners-Lee

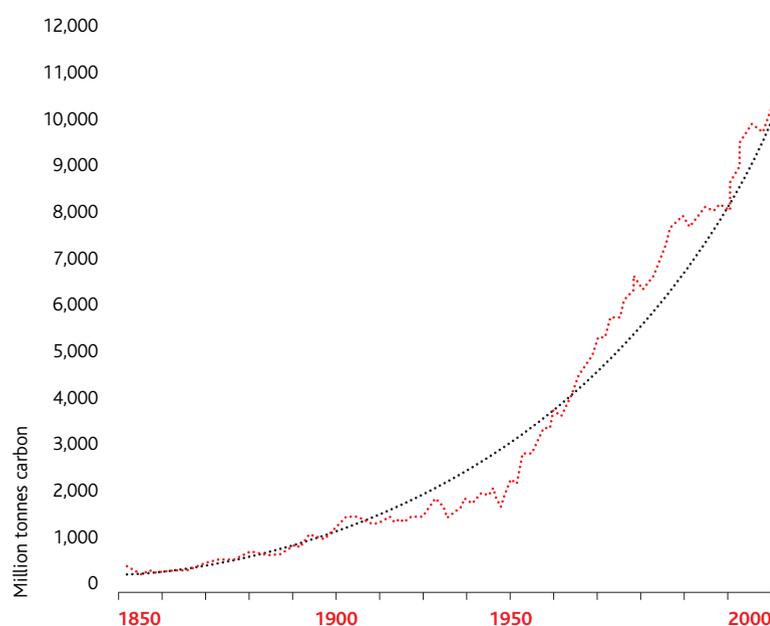
A History of Energy Growth

Every year, for a very long time, we humans have grown the economy. We have achieved this through a fundamental positive feedback mechanism; the plowing back of a small proportion of our available energy into an investment for the future. A few millennia ago this primarily took the form of holding back a small proportion of our food for replanting. A couple of centuries ago it importantly included using some of our coal, not for our own consumption needs, but to drive the pump engines that would drain the mines and enable the extraction of yet more coal. Since records began, in about 1850, our energy growth has been an incredibly steady and predictable process. We have maintained a more or less constant energy growth of 2.4 percent per year, with only small deviations—which are no more than random noise—from a mathematically exponential curve. And through our energy we have enabled the entire economy.

A History of Emissions Growth

Since 1850, energy growth has come largely from fossil fuel and therefore it is no surprise to find that carbon emissions from human energy use have also grown exponentially, mirroring that of energy growth. The only real difference in the trajectories of energy and carbon is that emissions have grown at only three quarters of the rate—1.8 percent—with the difference in growth

Figure 1: Annual carbon emissions (fossil energy + land use change)



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rates being accounted for by a continuous carbon efficiency improvement of 0.6 percent per year.

A Historical Link between Carbon and Money

Since the growth of emissions and world GDP have gone hand in hand, some have called, radically, for an end to economic growth itself as the only and essential way to cut emissions. But, while it is true that we have to cut emissions, there are *two*, not one, logical possibilities: cut the economy *or* break the long-standing link between the economy and fossil fuel.

A New Choice

It is clear that investment drives our growth, but what we also need to grasp is that the *shape* of our growth, what we grow *into*, is defined by *what* we invest in. Growth in energy and growth in carbon have gone hand in hand for the last hundred and seventy years because most of our energy investment has gone into fossil fuels. We have invested in finding new reserves, working out how to get them out of the ground efficiently, building pipelines, tankers, terminals, and filling stations to deliver them to anyone who wants them and can pay for them. Additionally, we have invested in the products that burn them for a million different uses.

The form of our growth and the *direction* in which we expand is determined by exactly *what* we invest in. We owe a huge debt, mainly of gratitude, for everything that fossil fuel has given us to date. However, the circumstances have now changed. We need to invest differently to steer a different course. Our investments determine our future.

While it is essential that we stop investing in fossil fuel, it is equally important that we start investing elsewhere. The good news is that money taken from one can amply fund the other. Subsidies can really be seen as just state-funded investment, and taxes as the opposite: state-organized disinvestment.

So far I have described how the shape of our investment determines our future—and how we have chosen a fossil fuel future through fuel investment. That was appropriate in its day, but it is time for an urgent change. Next I am going to outline why it is so urgent to pull out of fossil fuels and why the liberated investment is so urgently needed.

The Urgency of Cutting Carbon Investment

At this point, a very quick tour of some key numbers is important. Much of the broad arguments that I skim over here first hit the popular press in 2011 with Bill McKibben's famous "Do the Math" article in *Rolling Stone* magazine. Months later Duncan Clark and I published our book *The Burning Question*, in which we also drew strongly on papers by Andrew Jarvis at Lancaster University and many helpful discussions. Similar analyses, sometimes with slightly varying numbers, can be found in the IPCC reports and a range of think tanks. The next three paragraphs are now well trodden ground about which we need to be crystal clear.

Following the Paris summit of 2015, the world has at long last agreed that temperature rise should be kept below two degrees and ideally below one and a half degrees. The science is clear that in the absence of emerging and yet-to-emerge technologies for taking greenhouse gases out of the atmosphere, this puts an all-time total budget on our carbon emissions. Furthermore, there is good consensus, at least in rough terms, about how much of that budget has been spent and how much remains to stand a good chance (carefully defined by the IPCC as meaning a 66 percent chance) of limiting temperature rise to two degrees. This can be used to work out how much fuel we can burn from now on. The total fuel budget can be compared to estimates of the total fossil fuel reserves that exist. These estimates are not exact, but reserves are described in different ways: "proven reserves" (95 percent probability of being profitable to extract with today's technology and prices), "probable reserves" (50 percent chance) and "resources" (extractable, but not necessarily profitable with current technology and today's prices).

Figure 2 shows that we have far more fuel in the ground than we can possibly burn to stay within two degrees. Considering this limit, we can't burn more than a small fraction of the oil and gas available, even if we were to leave all the coal in the ground. Our fossil fuel problem is one of abundance, not scarcity. In fact if only we had a scarcity problem, we might even be saved from having to take effective deliberate action on climate change. And far from being drained by human usage, net fossil fuel reserves and resources are going up all the time. Powered by current investment, new reserves are continually being discovered and new technologies are being developed for extracting them profitably; from the Arctic, from shale, from tar sands, from the deep sea and so on.

One thing is dazzlingly clear: we need fossil fuel investment like we need a hole in the head. Investment in yet more coal, oil and gas either has to be written off or it will be used to take us into a future that the world has finally agreed is highly dangerous.

The Equal Urgency of Diverting that Investment Elsewhere

The very good news is that by eliminating fossil fuel investment, cutting subsidies and imposing taxes on fossil fuel, enormous funds will be redirected from the creation of a highly dangerous future to the enablement of a better future for us and our children. The word divestment sounds inherently negative, but we must remember that it comes with an equally and opposite positive counterpart: the liberated opportunity to invest elsewhere. In the same way tax is often talked about as negative, but it is essential to remember that the other side of the coin is the funding opportunity that taxes generate.

So we know we need to divest and tax fossil fuel, and cut subsidies. We know that this frees us to invest in a different kind of growth. The questions, then, are what shall we choose in its place, and will it be good enough to enable us to live well.

Critical Investments

1. Renewable Energy

Energy growth has been tremendously consistent since records began, and probably since the pyramids were built by hand, perhaps even well before that too. There are some who advocate breaking that long-standing trend, and perhaps they are right in that we could and should—but for now let us be conservative in our thinking and assume that the “business-as-usual” long-term energy growth trend of 2.4 percent is either desirable or inevitable or both. If this is the case we had better substitute fossil fuel for renewables at speed. Luckily everything is set for a solar revolution. The only thing missing is the scale of investment to enable its domination of human energy supply. Global growth rates of solar power are in excess of 30 percent per year. Costs are starting to rival or beat fossil fuels and look to be falling by about 10 percent every time total capacity doubles. By ignoring rooftop installations, both BP and the International Energy Agency grossly underestimate

total global solar power at around half of a percent of world energy, whereas in reality it is probably at least double that. If growth rates could stay at their current level, we would be awash of green power by 2030. Clearly, keeping the growth rate high as the scale increases is a challenge but there are no inherent barriers to total capacity. There is no foreseeable land shortage and no shortage of raw materials to make the solar panels. The most critical factor for the growth rate is the investment level.

While solar is the number one renewable energy good news story, not everywhere in the world is well placed for solar power. Luckily, many of the less sunny places have great wind and wave potential. So, in the global mix, these technologies are also of key importance. They too are doing well and require investment.

2. Transport from Solar Energy

Liquid hydrocarbon fuel has the great advantage of being a compact and lightweight energy store. For all the pollution, noise and grime it produces, it has enabled cars to travel hundreds of miles without refueling and planes to fly halfway around the world carrying all their energy needs on board.

The low-carbon world needs to invest in the technology and infrastructure necessary for the electric car to produce similar results. The most critical element of this is probably battery technology: we need lightweight, durable, non-toxic storage for billions of cars without trashing the world’s mineral resources.

For air transport, there is currently no alternative on the horizon to liquid fuels, so we either need to make them directly from solar energy, or grow them as biofuel. The former requires the development of emerging technology, while the latter requires smart investment in food and land systems in order to create the capacity for biofuel without trashing biodiversity or causing hunger, even as the population rises to ten billion or more.

3. Infrastructure for Low-Energy Living

This includes smart urban design and the retrofitting of energy efficiency into old building stock, with the priority to target the buildings that leak the most energy, such as the worst parts of the UK’s creaky old housing stock, along with retrofitting basic insulation and low-energy lighting. The urban design priorities are to enable life without daily car use. Towns and cities need to be compact rather than sprawling, so that life can be

conducted comfortably on foot or by bike, with huge benefits for well-being as well as carbon. We need to divest from sprawling suburban detached housing projects so that we can invest instead in compact city centers.

4. Carbon Capture

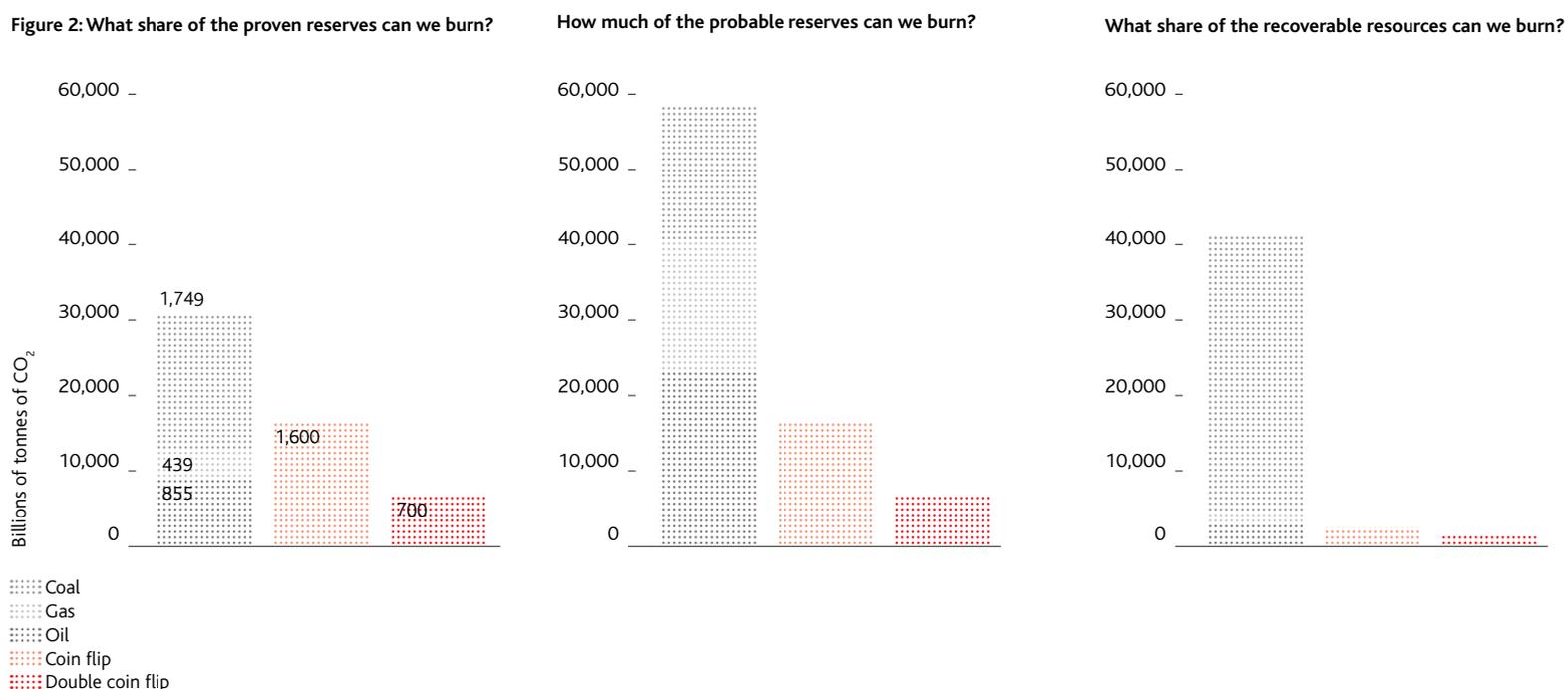
Carbon capture matters hugely because all realistic scenarios for limiting temperature change to two degrees or less depend on taking carbon back out of the air. At whatever level we finally cap our emissions, we will still encounter some adverse effects of climatic change, and so risk triggering more catastrophic changes, perhaps of a kind that we don't even yet envisage. Taking a clear-eyed look at humankind's lack of light-footedness so far on the climate change challenge, it is highly likely that we overspend our two degree budget, perhaps by a long way. Given all this, it makes incredibly good sense to develop and deploy technologies for sequestering carbon. Neither of these will take off without not-for-profit investment and/or subsidies and taxes in place, because there is very little salable utility to be had from either of them. Carbon capture and storage from power plants simply adds to the cost of electricity. To be clear, the free market is simply unable to support carbon capture.

Our divestment from fossil fuels and our emissions taxes can powerfully enable two types of carbon capture. The first of these is the roll out of carbon capture and storage at the point of combustion. This technology is just about

ready to go whenever the funding arrives and is useful while fossil fuel persists in the energy mix, even though it will only ever be capable of capturing a modest proportion of our emissions. The second is the development and deployment of technologies for the extraction of carbon from ambient air. Although this is in a much earlier stage of development, all the responsible climate scenarios now rely upon its deployment to reduce atmospheric carbon from an unavoidably high peak. Four years ago I remember writing that it would be unwise to rely on such an uncertain emerging technology. Now I write that however uncomfortable this might be, we need to roll back the clock and undo damage that we will have caused. When I hear speculation that this technology looks to be decades away I can't resist turning to the British wartime analogies that I was brought up with of the urgent development of radar, Spitfires, and code cracking machines at super-high speeds. It is very difficult to say how fast development might be possible. Since we just don't know, it is uncomfortable to rely on it, but given that in the best of cases it could be a game-changer, we should still push for it hard—through investment.

5. Land and Food Investments

The global land and food system is in urgent need of improvement. While we grow more than twice the edible calories that we require, there are huge problems in the journey from field to fork that result in not everyone getting the nutrition they need. Meanwhile we



What we need to divest from, and what critical investment opportunities this will create, will allow us to deliver a future that we can look forward to for ourselves and the generations to come

are trashing our biodiversity at an alarming rate and pouring greenhouse gasses into the atmosphere through our land use, to the extent that agriculture is responsible for between a quarter and a third of all greenhouse gasses.

Many of the necessary improvements should not require multi-billion dollar investments. The single most important change will be an amazingly simple dietary shift towards less meat and dairy consumption, with a particular focus on reducing beef. This will markedly reduce greenhouse gasses, improve the nutritional output of our land and, by relieving land pressure, ought to be pivotal in stemming deforestation. The net infrastructure investment requirement should be nothing—or perhaps even less than that! We also need to cut waste throughout the food chain but, here again, the infrastructure requirements are not vast.

However, there are two critical areas for which investment is required. The first is research. We don't yet know nearly enough about the impact of different arable practices on the environment and, in particular, what farming systems store or release carbon and in what quantities. Research is needed into how to grow efficiently while encouraging biodiversity. There are promising manufactured alternatives to meat that need further looking into. We also need to understand how land can be used to create the liquid hydrocarbons that we will almost certainly need if we are to continue with aviation in the low-carbon world.

The second area in which investment is needed concerns farmers. We need to understand that the best ways of dealing with our land are not the cheapest. To do a really good job of producing food, cutting emissions and promoting biodiversity care and attention are needed. It requires plenty of people. The good news is that we have more of this resource than ever before, and will soon have at least another couple of billion more still. For the past couple of centuries we have been looking to minimize the number of people working on the land. This is crazy, given the abundance of person power. We should be looking to employ *more* people to do a *better* and more careful job of looking after our land and growing our food. We need to invest in farmers and subsidize them to do the right things. The money for this, of course, is made available by ceasing the deeply unhelpful subsidy of fossil fuels, divesting from them and better still, applying serious taxes.

How much funding can divestment and the withdrawal of subsidies liberate? In 2013 global investment in fossil

fuels stood at over a trillion dollars while investment in renewables stood at just a couple of hundred billion.

For a two-degree world, the remaining carbon budget is roughly three hundred billion tons CO₂. Imagine a carbon tax of \$300 per ton. This sounds high to many people—it would, for instance, add about a dollar to a liter of gasoline. The funds raised, however, would be around \$90 trillion—if half of that were distributed as a \$6,000 life subsidy to every adult and child in the world, the global reduction of inequality would be significant. Those who burned more fuel would still be worse off, but those who were frugal would be richer. Meanwhile a colossal \$45 trillion investment pot could transform the energy landscape. Pension schemes that might suffer from the drop of fossil fuel assets could be compensated to top up the profits from their re-investment in the low-carbon world, and even oil companies could be subsidized in developing their low-carbon business models.

What Does this Mean in Practice?

Every financial decision is an investment in one kind of future or another. At the small scale, every small buying decision supports a supply chain and rejects others. Even bike maintenance is an investment in low carbon infrastructure. At the higher end of personal decisions, pensions and housing stand out. Pension portfolios now require scrutiny not just for the returns they offer but for the type of global future they support. Those signed up to employee schemes may feel powerless, but can still help by making their views known at work. Housing investments can support energy efficient homes and sustainable urban design, rather than suburban sprawls of leaky homes that necessitate long commutes and high energy consumption.

For businesses and governments, exactly the same principles apply for all investments and spending, taxes and subsidies. Fossil fuels need taxing and, of course, their subsidies removing. The same goes for related infrastructure and research and development. The revenue raised here can be used to invest in the critical areas outlined above as well as to provide a degree of temporary support for industries and people made unavoidably vulnerable by the speed of transition. Just as at the individual level, company and state pension scheme portfolios stand out as key investment areas to get right. Obviously and importantly, electricity can be purchased from renewable sources; and this is becoming

a more mainstream option, even among large corporations. But beyond this, every line in the purchase ledger steers the future towards or away from fossil fuels; towards or away from a future we would wish for our children.

Delivering Sustainable Consumption and Production

Arab Hoballah

Gargantuan Consumption and Production Cycles

Correcting the mistakes of industrialization, reversing pollution, rehabilitating damaged ecosystems, eradicating poverty, promoting education, and sustaining inclusive green economy require tremendous amounts of resources—mainly financial resources, in the region of hundreds of trillions of dollars and euros and yuans. This much is evident, though I will not be listing here the various amounts needed, largely reported elsewhere by a number of media outlets. Equally evident is the fact that the general investment policies, financial mechanisms and banking systems developed over at least the last century have largely contributed to current economic, social and environmental crises.

Without rejecting the benefits of development in terms of education, health, freedom and technology, it must be admitted that as a consequence of unsustainable growth the world is currently faced with the risk of economic, social and environmental breakdown.

Policies and markets need to be seriously reformed, with the financial system at the service of sustainable development and not the other way around, in order to facilitate a badly needed transformative change through the promotion of resource efficiency and the adoption of sustainable consumption and production patterns, particularly in cities.

With the exception of a few irresponsible business and political leaders blinded by their thirst for unbounded wealth, it is duly recognized that we are going through an unprecedented era, the Anthropocene, in which the world's population is consuming more resources than the planet is capable of producing.

Over the last decade there has been increasing recognition that to effectively deliver policy outcomes it is crucial to change people's behavior. While the concept of sustainable development has gained ground in recent decades, this has taken place in parallel with a dangerous rising trend of patterns of unsustainable consumption and production. Presently we consume over one and a half times more resources than the Earth can provide, and well before 2050 we will need more than two Earths to meet our gargantuan consumption habits. Meeting the challenge of shifting consumer preferences towards more “green” behavioral patterns as well as effectively integrating sustainability parameters in the business and industry decision-making process requires an in-depth structural transformative change—and one, at that, which takes standard practices away from counterproductive “greenwashing” strategies.

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Today, our consumption habits are depleting key resources and destroying various ecosystems. The number of things we use in our daily lives has increased exponentially in many parts of the world. Global extraction of raw material has tripled over the past four decades, rising to an annual figure of 70 billion tons in 2010, and is currently expected to reach 140 billion tons by 2030. This surge in the amount of material we consume is underpinned by growing populations, the middle class expanding, and higher income per capita worldwide. For a variety of economic and social reasons these trends are unstoppable, which makes it imperative that we change the way we produce and consume, doing more with less, if we are to achieve sustainable development.

The international community has increasingly realized that it is important and indeed imperative to change our unsustainable consumption and production patterns if we are to eradicate poverty and deliver sustainable development. This has resulted in the adoption at Rio+20 of the Ten-Year Framework of Programs on Sustainable Consumption and Production (SCP) and the inclusion among the seventeen Sustainable Development Goals (SDGs) of a stand-alone goal on SCP, together with related targets in most of the other goals, showing the cross-cutting nature of SCP in support of sustainable development. In this same spirit, the COP21 Paris Agreement has highlighted that sustainable lifestyles and sustainable patterns of consumption and production, with developed countries leading the effort to achieve them, play an important role in addressing climate change.

Uncertain Transition: Resource Efficiency First

There are encouraging signs that society is beginning to understand the absolute need to change our unsustainable consumption and production patterns. Terms such as “efficiency,” “decoupling,” “decarbonizing,” “quality of life” and “sustainable lifestyles” regularly appear in the media, illustrating the fact that people, governments and businesses are already weaving sustainability into their daily decision-making. Carbon footprint monitoring, food waste reduction campaigns, urban gardening, vehicle-pooling models, and sharing economy, as well as surveys to understand the values and motivations of youth, are among the tools currently helping people to make more sustainable consumption and production decisions.

Yet these actions are often piecemeal. They are not yet framed within a holistic vision of what constitutes a sustainable lifestyle, nor are they supported by reliable information to guide consumer choice towards sustainable goods and services, or, generally speaking, by government policies to the same effect. Consumer action and choice as well as government policies will be necessary to reduce the unsustainable impact of our current consumption levels, particularly in developed countries, and to generate a supply of sustainable products to make the adoption of more sustainable lifestyles a realizable goal in all countries.

Take the “simple” example of buildings: green, low-carbon or passive buildings likely constitute the single most important sector for reducing energy use and CO₂ emissions, with criteria and labeling systems already in place in many countries. But despite their huge potential, the actual number of such green buildings to have emerged since this was identified by the Intergovernmental Panel on Climate Change (IPCC) as the low-hanging fruit in terms of reduction of greenhouse gases (GHGs) emissions is just a drop in a vast ocean of opportunities. Cities and countries can save billions and trillions of dollars if a low-carbon and resource-efficiency policy is applied across the board in the construction sector by retrofitting older structures, erecting new high-quality buildings and also, if not mainly, developing suitable social housing programs.

Many of the solutions we require to achieve the shift to sustainable consumption and production patterns do not rest with the ultimate consumers of products. Living sustainably is not just about individual choice: it is also about ensuring that governments enact policies that guide people towards this type of lifestyles, that guide and enable markets to adapt accordingly, and that increase the offer of sustainable goods and services to provide consumers with the necessary choices. Though people are end consumers, most of the decisions around goods and services, and their associated impacts, are taken at much earlier stages in their design, production and delivery.

Here is where the public sector can wield a critical influence, stimulating both the production of and demand for sustainable products by implementing sustainable public procurement policies. Government purchasing accounts for between 15 and 30 percent of the sales of goods and services in domestic markets around the world. This is generally closer to 15 percent in most developed countries, but reaches 30 percent in some developing countries. Not only does this market share

Presently we consume over one and a half times more resources than the Earth can provide, and well before 2050 we will need more than two Earths to meet our gargantuan consumption habits

offer a significant opportunity to send a clear signal to producers regarding the need for sustainable products, it also means that green or sustainable public procurement policies can be aligned with government policies supporting related social and environmental objectives.

Existing initiatives from around the globe, such as replacing incandescent light bulbs with energy-efficient fluorescent lamps in all public buildings and public areas, institutionalizing and applying recycling policies, reducing food wastes in enterprises, restaurants and schools as well as university canteens, or reducing and even eliminating harmful substances in production processes and consumer products, prove that sustainable procurement transforms markets, boosts environmentally friendly industries, saves money, conserves natural resources and fosters job creation.

Given the size and scope of the challenges faced and the actions required, it is necessary for public and private decision makers as well as the civil society to achieve greater understanding and implementation of policies that deliver resource efficiency and SCP. To that end, applying life-cycle thinking is essential to identify and prioritize the relevant policies and practices. This in turn must go hand in hand with the systemic thinking necessary for sustainability, integrating resource efficiency in global value chains by using life-cycle data on environmental impact, thus enabling private and public organizations to make informed choices leading to increased SCP.

Promoting resource efficiency throughout the production process is essential to advance a circular economy and an inclusive green economy, in particular by enabling the effective development, application, adaptation and replication of resource-efficient and cleaner production concepts, methods, policies, practices and technologies in industries and businesses, focusing especially on small- and medium-sized enterprises (SMEs).

In this context, the development of eco-innovation and the application of an innovative business model that incorporates sustainability and life-cycle thinking throughout all business operations and in cooperation with partners across the value chain will save businesses material and financial resources. For this reason they will be in a better position to access matching funds from financial institutions to further expand their activities. This strategy entails a coordinated set of modifications or novel solutions to products (goods/services), processes, market approach and organizational structure, which

leads to a company's enhanced performance and competitiveness.

The "Easy" Case of Energy: Efficiency versus New, Alternative and Renewable

The unprecedented rates at which we are presently experiencing technical change have resulted in much prosperity, but have also presented us with a range of daunting challenges. In order to mitigate and adapt to the effects of climate change we must pay serious attention to promoting and scaling up resource efficiency in all sectors and all countries. Nevertheless, the global community has given priority to GHGs emissions and energy crises, devoting more attention and investments to finding new and renewable energy sources than to optimizing efficiency as a means to reduce energy use in most industrial and consumption sectors. In many cases the business-as-usual patterns of industrial production and consumption remain fundamentally the same—that is, wasteful—even if alternative or renewable resources are used where possible. By contrast, savings from efficiency and productivity throughout the value chain are simply gigantic, both in terms of material saved per product and other resources (including energy) needed per product.

In this context, energy transition should provide access to energy at a lower cost to the environment. Energy transition will be the result of a combination of actions, of which energy efficiency is a significant part. Indeed, abatement of the GHGs that cause global warming and climate change can be achieved by: a) using energy more efficiently; b) shifting to means of energy supply that cause fewer emissions; c) better managing biomass resources to reduce emissions where they occur and to create sinks for carbon where possible; d) changing behavior towards lower energy lifestyles. All these changes in the sources and use of energy can make a fundamental contribution towards achieving patterns of sustainable consumption and production.

Resource efficiency, in particular when it comes to energy, is relevant for both developed and developing countries, especially considering that about three billion additional middle class consumers will arise around 2050. Many of these will be found in emerging countries, which by then will aspire to the same level of consumption as current developed ones. Investments in energy productivity can create new jobs, foster economic growth, reduce energy bills for families and make

business operations more profitable. Additionally, in developing countries savings from energy efficiency could contribute to making modern energy services available to the whole population and at the same time support eco-innovation.

But the efficient use of resources, including the "easy" case of energy, will be critical to bring about that goal. The reduction of GHGs emission can be achieved through technological innovation and behavioral changes which lead to the adoption of less energy-intensive lifestyles. These changes include, for instance, choosing more energy-efficient goods and services. Savings generated by more efficient production and consumption of energy can make a fundamental contribution to mobilizing financial resources and unlocking investment capital towards other development priorities such as education and health, once basic needs for all are guaranteed.

Cities: "To Be Sustainable or Not to Be"

Cities are responsible for most of the consumption and production of energy today. As the phenomenon of urbanization keeps growing the importance of city-level action will be reinforced, making cities the focal point of the efforts to deliver sustainable solutions to the production of goods and enable consumers to make responsible choices. The road towards achieving SCP through city-level action, however, starts with buildings, the most readily accessible means of advancing energy efficiency and the reduction of CO₂ emissions.

In applying sustainable consumption and production, cities can act as catalysts in the promotion of sustainable development. The New Urban Agenda, prepared through the Habitat III process, provides an opportunity to focus on vertical and horizontal integration and the implementation of the SDGs at the city level. Promoting resource efficiency in cities will increase their economic resilience, contribute to climate change mitigation, and reduce waste and associated costs, while also improving quality of life.

To that end it is essential that all countries, starting with leading economies such as those under the G20, engage more proactively in an objective and responsible low-carbon agenda, bringing together central and local governments and businesses in a long-term strategic alliance with the aim of delivering the urgently needed transformative change in policy frameworks and actions, in market evolution and lifestyles, towards responsible

The global community has devoted more attention and investments to finding new and renewable energy sources than to optimizing efficiency as a means to reduce energy use in most industrial and consumption sectors

and sustainable consumption and production patterns to achieve sustainability.

Many of the problems attributed to cities are consequences of past and current policies and action plans for economic growth and consumer behavior. In this context it is particularly important to take into consideration the growing global middle class, who are not only expected to live longer due to improvements in health care but are also characterized by their increased purchasing capacity. Considering the previously mentioned expected increase over the next thirty years of three billion people belonging to the middle class, cities can be thought of as the “industries of the three-quarters” in the sense that, as an order of magnitude, cities will host about three quarters—between 70 and 90 percent, depending on sector and region—of the population, GDP, resources use, waste production, and CO₂ emissions of the world. This is to say that there could be no sustainability if not at city level and with resource-efficient cities looking to deliver sustainable consumption and production.

However this requires proper knowledge and understanding of urban metabolism, in particular resource flows to and within cities. Considering the huge pressures cities will be facing in terms of supply and demand of resources, there is a need to support cities and their networks in better identifying and realizing the economic, social and environmental benefits of resource efficiency and sustainable consumption and production. This in turn will result in cities, and therefore also countries, being more resilient on the back of resulting climate change mitigation actions.

Ultimately, resource-efficient cities combine greater productivity and innovation with lower costs and reduced environmental impact, making them the engines of sustainability. Increasing demand for consumption products will mainly occur in cities. Hence, depending on their consumption patterns and demand for low-carbon resource-efficient products, they will drive overall development towards sustainability or away from it. In the same order of ideas, innovation in hard and soft infrastructure will improve resource management in cities and provide a plan of action that could easily be replicated in a large number of urban areas—a perfect opportunity for some cities, especially middle-sized ones, to lead by example.

To conclude, if governments are serious about sustainable development and looking for responsible actions to effect a truly transformative long-term change,

the focus should be increasingly on promoting sustainable consumption and production, notably through resource-efficient cities with relevant policies and sound governance, developing adequate market instruments and enabling capacity at all levels. Therefore, by improving productivity and efficiency in-house, in-industry, in-city, and by delivering sustainable consumption and production, countries and governments, businesses, industries, and society in general will be better equipped to cope with the investment necessary to further consolidate and strengthen the transition towards sustainable development.

Regenerative Development

Raymond J. Cole

Despite having greater scientific understanding of human-induced stresses on natural systems and unprecedented individual and collective access to that information, political leaders and the public have been slow to embrace the seriousness of climate change and environmental degradation. Such issues remain compromised in the political realm by a host of other seemingly more pressing concerns—geostrategic competition, mass human migration, terrorism, and the immediate outfall from increasingly common severe weather events. The public's priorities, one assumes, will inevitably change as it becomes aware of how the latter are affecting their personal property, food prices, water supply, and so on, and that their individual and collective choices are complicit in global warming and associated climate instability.

Legislation, if possible to enforce, has historically been viewed as one of the most appropriate means of combating localized environmental transgressions, particularly if sufficient information is available to formulate workable regulations, set targets and measure their effectiveness. Although legislation and regulation will likely remain important in reducing anthropogenic carbon emissions, a greater level of cooperation and voluntary agreements between stakeholders and regulating bodies would seem necessary to more fundamentally address climate change mitigation.

The energy and resource use and greenhouse gas emissions associated with the construction and operation of buildings are acknowledged as a major cause of both global warming and environmental degradation. Importantly, the fourth Intergovernmental Panel on Climate Change (IPCC) report recognized that buildings offer the largest low-cost potential carbon reductions in all world regions and will play a critical part of any global low carbon future. How we—individually and collectively—understand and respond to climate change and, in particular, what we build, how we build and where we build as well as how we use buildings, will prove central to any meaningful transition to a sustainable future.

Maintaining a measure of criticality toward the nature of an impending set of environmental difficulties that must be navigated, and simultaneously offering a positive, hopeful message and perspective is not an easy task. To encourage people to engage and respond to climate change and other environmental issues with a greater sense of urgency, persuasive appeals have consistently stressed the negative consequences of failing to ameliorate them. The IPCC's findings have, for example, been

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variously cast in terms of alarm, pessimism and a depressing possible future—notions that, although characterizing and conveying clear warning and risk, have failed to garner public attention and engagement. While scholars in the field of environmental psychology have offered evidence that providing information alone rarely leads to the expected or desired behavioral change, trying to convince the public by presenting a “bad news” storyline seems even more ineffectual. By contrast, a positive transformative vision that inspires hope, offers promise and creates the necessary cognitive space to explore new possibilities, is considered far more potent in encouraging collective action than the presentation of alarming facts and negative messages. Similar arguments apply to approaches to improve the environmental performance of buildings. What is commonly referred to as “green building” design, for example, has been almost exclusively directed at reducing the degenerative consequences of the built environment on the health and integrity of ecological systems rather than emphasizing positive outcomes.

A primary emphasis of current green building performance relates to that of individual buildings; this is the scale at which building codes focus and energy services are metered. The “endgame” of a “doing-less-harm” approach—doing no harm—has logically led to setting net-zero impact as an appropriate goal for environmental performance of individual buildings. Indeed, such an ambition is increasingly embedded in national energy policies with many countries declaring that all new buildings must conform to performance targets of net-zero energy and/or carbon neutral emission standards by a certain date.

Until recently, very little reference has been made to the considerable catalytic role that buildings can play in nurturing and supporting positive environmental outcomes. The notion of “net-positive” propositions and approaches to building design practice has now emerged wherein some buildings may offer the potential of collecting more energy and water than they need to support their requirements. In doing so, it is not surprising that the primacy of the individual building as the focus of energy strategies is also being seriously challenged with an emerging tendency to view buildings as potential resource nodes within a networked infrastructure, such as a district energy system or smart grid network.

If we accept that a building, in and of itself, cannot be sustainable but can be designed to support sustainable patterns of living, then the *role* the building plays is

potentially of greater consequence than the building itself. Such a viewpoint is central to the emerging notion of *regenerative* development wherein buildings, in addition to meeting their functional requirements, add other forms of “value” to the community such as improved social welfare, employment creation, new business opportunities and strengthening human connections with natural systems. Importantly, rather than reducing destructive impacts, the regenerative approaches see buildings as enabling the full potential of the social and ecological systems in which they sit. It would seem, therefore, that if buildings are to act as a catalyst for broader environmental change they must reestablish a meaningful connection to the places where they are situated.

The notion of regeneration—“rebirth” or “renewal”—has been variously applied in relation to the built environment and communities following major acts of devastation or when a prior condition has declined to an extent considered ripe for renewal—and, of course, where the commitment has been found to initiate rebuilding. The resulting transformed condition, while embodying traces from its past, is infused with new aspirations and possibilities. Over the past years, however, regeneration has been garnering increasing interest as a means of reframing green building practices and, carrying with it qualitatively different and broader connotations than used previously. John Lyle’s 1994 book *Regenerative Design for Sustainable Development* illustrated key differences between linear, single throughput processes and closed-loop processes with the attendant reduction in entropy. By contrast, current notions of regenerative development emphasize a coevolutionary, partnered relationship between humans and nature rather than a managerial one. Regenerative development represents the first approach to bridge human development with the physical and functional, emotional and spiritual attributes of nature. Within regenerative development it is not the building that is regenerated, in the sense of the self-healing and self-organizing attributes of a living system. Rather, it is the act of building which can become a catalyst for positive change within and add value to the unique place in which it is situated.

While regenerative approaches and practices are still evolving, books such as Dominique Hes and Chrisna du Plessis’s *Designing for Hope: Pathways to Regenerative Sustainability* (2014) and Pamela Mang and Ben Haggard’s *Regenerative Development and Design: A Framework for Evolving Sustainability* (2016) have provided both powerful justifications and understanding of the core

The latest Intergovernmental Panel on Climate Change (IPCC) report recognized that buildings offer the largest low-cost potential carbon reductions in all world regions

principles. Within regenerative development, stakeholder processes, buildings and their inhabitation are collectively focused on enhancing life in all its manifestations—human, other species, ecological systems—through an enduring responsibility of stewardship. Importantly, regenerative development effectively permits cross-scale, socio-ecological relationships and complex adaptive systems to frame approaches to building and infrastructure design.

Reducing the rate and scale of environmental degradation and engaging regenerative approaches are essential and complementary requirements in charting a sustainable future. The intention, language and more comprehensive framing of regenerative development offers considerable potential to accelerate the development of systems thinking, shared vision, shared ownership and shared responsibility. While the practice of “participatory design” expands the range of stakeholder input, authority and knowledge still reside largely with the professional design team. By contrast, regenerative approaches emphasize the coproduction of the built environment, greater equality between all stakeholders and demand more upfront time to discover what is valued. Consistent with Margaret Wheatley’s notion that people care about what they create, forging partnerships and changing the power relationships inherent in the production of buildings provides greater assurance that the initial ambitions of a project are maintained through time.

So why is regenerative design gaining prominence? Certainly in North America there has been the search for complementary or alternative performance aspirations and approaches to those both evident in, and as a result of, the US Leadership in Energy and Environment Design (LEED) green building rating system. While having proven to be an enormously valuable vehicle for mainstreaming green building practice, LEED’s checklist format is incapable of guiding design in a systems-approach manner and establishing positive links between buildings and their context. Moreover, while not diminishing the importance and necessity of reducing the degenerative impacts of buildings on natural systems, green design alone is insufficient responsibility and motivation compared to the aspirations of regenerative development.

The reaction against reductive, checklist-based assessment methods represents only a relatively minor reason for the increasing appeal of regenerative approaches. A much more fundamental basis for its appeal is born out of the convergence of a number of historical threads that have either been latent or running parallel to

conventional green-building discourse and practice over the past 30 years or so. While, many of its core tenets—systems thinking, community engagement, respect for place—have long individual histories in architectural discourse and practice, the regenerative approaches ties them together in a cogent manner.

In reframing building performance within regenerative development, there is the need to understand and reconcile a number of issues, including: the relationship between systems thinking and reductive approaches; the relationship between the performance of individual buildings and the larger context in which they are located; and the relationship between place- or region-specific approaches and globalized systems. What is perhaps the most significant and necessary shift does not reside in the strategic level, but in the mindset among design teams and clients. Here it becomes necessary to accept that the root causes of our current environmental predicament primarily result from differences between the workings of natural systems and human systems. Indeed, a major challenge we face this century resides in transforming what human beings value, instilling environmental stewardship as a societal priority and, in particular, aligning the global economy with the dictates of ecological sustainability.

A key tenet of regenerative development is reconnecting people with the unique places where they live and thereby developing the necessary sense of shared meaning, care and stewardship. Given the proliferation and pervasive use of information technology that permits immediate digital access from anywhere to anywhere, perhaps there is an even greater need to situate ourselves in identifiable and meaningful physical places designed for social interaction and engagement with nature. If, indeed, the experience of *place* provides the counter to the more abstract enveloping world of global information systems, then it will also be logically coupled with strategies that offer “slowness” in an ever-accelerating pace of life. The reemergence of the importance of place is clearly not confined to where and how we build and may also be a reaction and manifestation of people wanting to reclaim more control over their lives. Localism, for example, supports local production and consumption of goods, local control of government, and promotion of local history, local culture and local identity. Which societal needs can be reestablished and maintained at a local level and which remain within the domain of national and global production, trade and exchange, will clearly evolve according to the constraints and opportunities afforded by place.

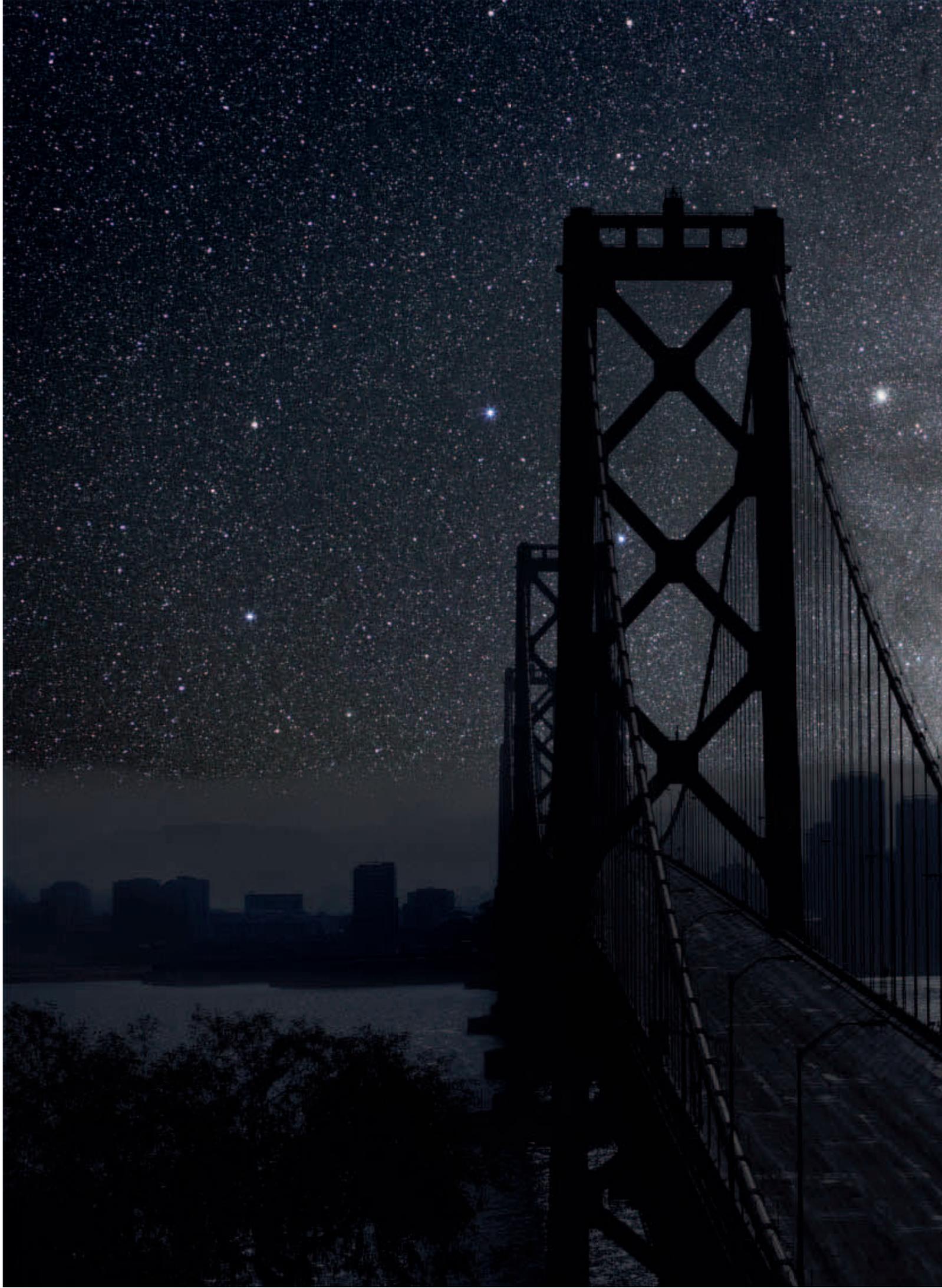
All human endeavor, including building-design priorities, are shaped by the prevailing worldview and value system of the societal and cultural context within which they emerge. Worldviews shape the underlying assumptions that drive what people believe about the world—the questions they ask, the solutions they seek and the methods they deploy to do so. Fundamental change will likely only occur through the replacement of the prevailing anthropocentric, mechanistic worldview by an ecological worldview that sees humans as integral to a larger community of life. This will not be easy or quick given that the prevailing worldview was some five hundred years in the making and is ingrained in all aspects of Western society and culture. However, Hess and du Plessis provide evidence that an alternative ecological worldview has been gaining ground and, given the increasing rate of dissemination of ideas afforded by information and communication technologies, one can anticipate a more rapid transition.

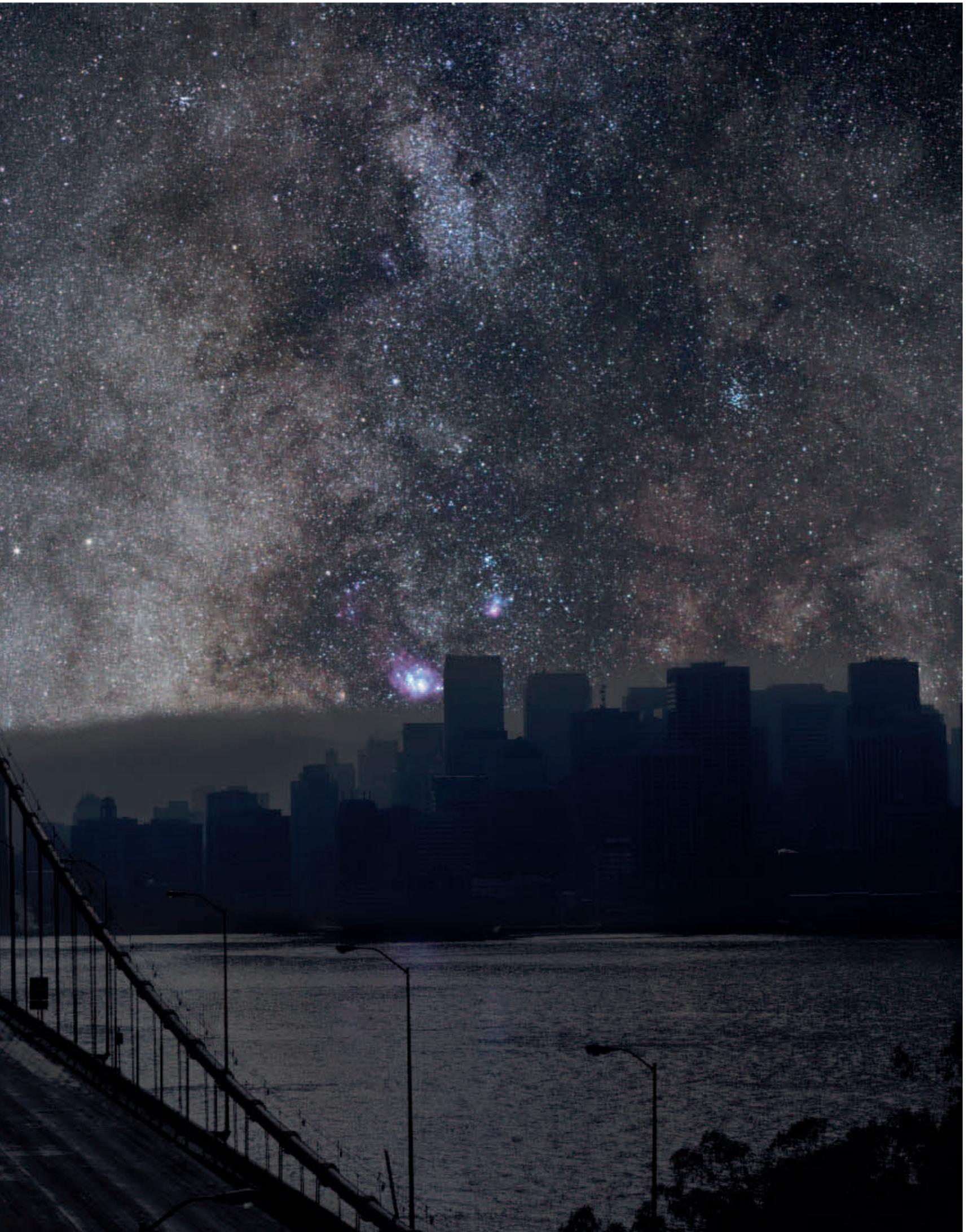
Although mitigation efforts to limit the extent of global warming will remain critical, there will be an increasing need to adapt to an uncertain and changing climate and environmental context triggered by past human activity. Indeed, adapting to a changing climate will likely emerge as a primary human preoccupation for decades to come. While continual change, uncertainty and unpredictability are characteristic of complex adaptive systems such as the built environment, human perceptual systems are, by contrast, oriented toward order, maintenance, optimization, and predictable outcomes. Rather than accepting and embracing uncertainty, Mang and Haggard argue that we have largely strived to make our lives more predictable and controllable through the deployment of increasingly energy-intensive technologies. Proponents of regenerative approaches see the self-healing abilities of living systems, the shift in rethinking building design in relation to natural systems and the innate human creative and entrepreneurial spirit as collectively offering a positive path through the uncertain future created by a changing climate. How these and other human endeavors coevolve with changing natural systems to the mutual benefit of each will likely distinguish future patterns of human settlement development from those in the past. Eventually perhaps, we will come to view the act of building not as destructive of natural systems and depleting the earth’s resources but as contributing to and supporting the creation of a thriving, resilient and abundant world.

Darkened Cities Thierry Cohen

With his series of photographs *Darkened Cities*, Thierry Cohen (France, 1965) recreates the fantasy of an urban sky full of stars. He does this by photographing the world's main cities by day, and deserts, plains and other places free of light pollution by night. By mounting the two shots, he creates a unique new image infused with a fascinating and impossible beauty.

San Francisco 37° 48' 30" N 2010-10-09 LST 20:58



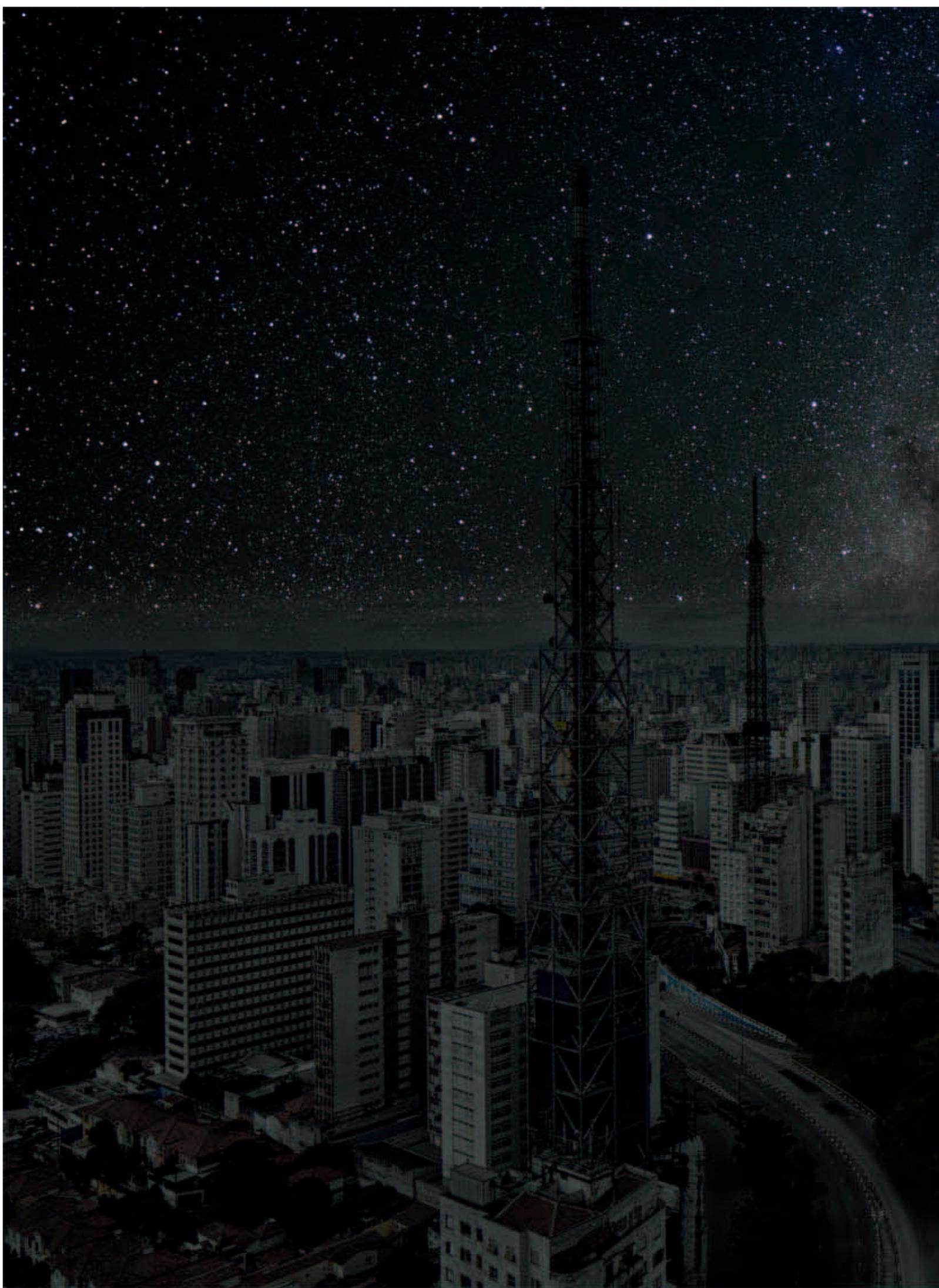


Shanghai 31° 12' 44" N 2012-03-18 LST 15:20





São Paulo 23° 33' 22" S 2011-06-05 LST 11:44





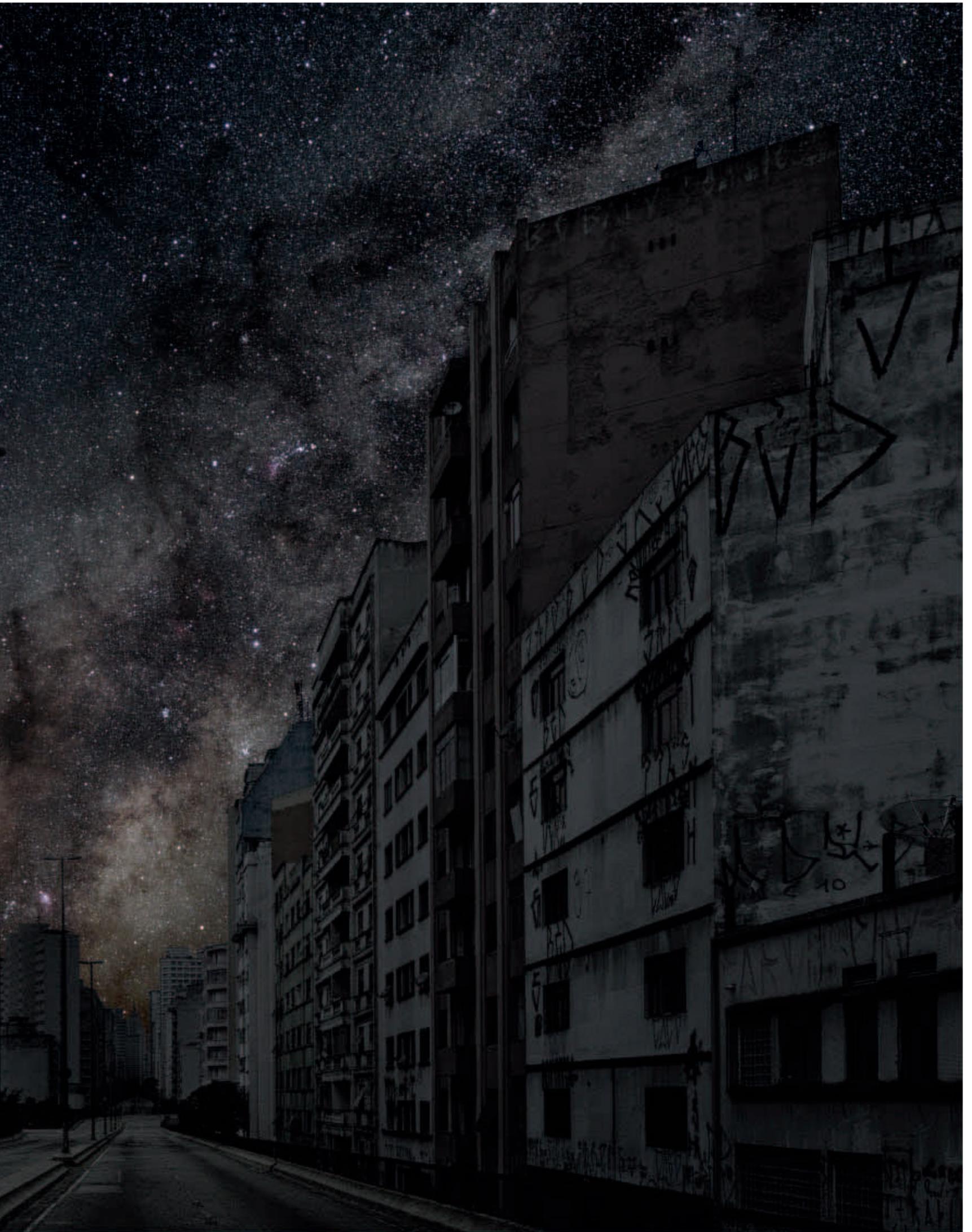
Los Angeles 34° 06' 58" N 2012-06-15 LST 14:52





São Paulo 23° 32' 09" S 2011-06-07 LST 11:52





Paris 48° 52' 16" N 2012-06-17 LST 17:30





London 51° 30' 44" N 2015-02-19 LST 14:08





Environmental
organizations, scientists
and parliamentarians
have called for the
world's religious leaders
to respond to the
environmental crisis

Mary Evelyn Tucker

6.
Different Visions.
One Planet, One City

When entrepreneurs are faced with public officials ready to take bribes, they are able to ignore environmental regulations

Víctor Lapuente

Intermediary cities are the meeting point between the rural and urban worlds, and they provide an opportunity to generate a civic and democratic space that large cities or metropolises can no longer permit themselves so easily

Firdaous Oussidhoum

World Religions and Ecology

Mary Evelyn Tucker

The environmental crisis is a pressing issue which has been well documented in its various interlocking manifestations of industrial pollution, resource depletion, and population explosion.

The moral imperative and value systems of religions are indispensable in mobilizing the sensibilities of people toward preserving the environment for future generations. Clearly religions need to be involved with the development of a more comprehensive worldview and ethics. Whether from an anthropocentric or a biocentric perspective, more adequate environmental values need to be formulated and linked to areas of science and public policy.

One of the greatest challenges to contemporary religions is how to respond to the environmental crisis which some believe has been perpetuated by the enormous inroads of materialism and secularization in contemporary societies. Others such as the medieval historian Lynn White have suggested that the emphasis in Judaism and Christianity on the transcendence of God above nature and the dominion of humans over nature has led to a devaluing of the natural world and a subsequent destruction of its resources for utilitarian ends.

Be that as it may, what is necessary is, as the historian of religions Thomas Berry has so aptly pointed out, a comprehensive reevaluation of human-Earth relations if the human is to continue as a viable species on an increasingly degraded planet. Indeed, he said that our challenge was to develop ethics not just for homicide, suicide, or genocide but also for biocide or geocide.

In addition to major economic and political changes, this will require adopting worldviews that differ from those which have captured the imagination of contemporary industrialized societies that often view nature simply as a commodity to be exploited.

Ethics and Sustainability

The focus of ethics in the world's religions has been largely human-centered. While some have critiqued this anthropocentric perspective of world religions as rather narrow in light of environmental degradation and the loss of species, it is nonetheless important to recall that this perspective has also helped to promote major movements for social justice and human rights.

Social justice and environmental integrity are now being seen as part of a continuum. For some decades

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environmental philosophers have been developing the field of environmental ethics that can now provide enormous resources for the world's religions in considering how to expand their ethical focus. Emerging biocentric and ecocentric ethics are attentive to life forms and ecosystems within a planetary context.

Thus religions are gradually moving from exclusively anthropocentric ethics to ecocentric ethics and even to "anthropocosmic" ethics. The latter is a term used by Tu Weiming to describe the vibrant interaction of cosmos, Earth, and humans in a Confucian worldview.¹ In this context, humans complete the natural and cosmic world and become participants in the dynamic transformative life processes. This is a fruitful yet still emerging path toward a comprehensive ethics for sustainability.

Social and Historical Context

Through intolerance and exclusive claims to truth, world religions have often contributed to tensions between peoples, including wars or forced conversion. But religions have also often been at the forefront of reforms, such as in the labor movement, in immigration law, in justice for the poor and oppressed. The movements of non-violence for freedom in India and for integration in the United States were inspired by religious principles and led by religious leaders such as Gandhi and Martin Luther King.

The emerging dialogue on religion and ecology also acknowledges that in seeking long-term environmental sustainability, there is clearly a disjunction between contemporary problems regarding the environment and traditional religions as resources, which are not necessarily equipped to supply specific guidance in dealing with complex issues such as climate change, desertification, or deforestation. At the same time one recognizes that certain orientations and values from the world's religions may not only be useful but even indispensable for a more comprehensive cosmological orientation and environmental ethics.

Scholars of religion and ecology acknowledge that religious scriptures and commentaries were written in an earlier age with a different audience in mind. Similarly, many of the myths and rituals of the world's religions were developed in earlier historical contexts, frequently agricultural, while the art and symbols were created within worldviews very different from our own. Likewise, the ethics and morality of the world's religions respond primarily to anthropocentric perspectives regarding the

importance of human-human relations, and views of salvation and spirituality are generally formulated in relation to enhancing divine-human relations.

Despite these historical and cultural contingencies, there are particular religious attitudes and practices as well as common ethical values that can be identified for broadening and deepening environmental perspectives. Thus we affirm the actual and potential contribution of religious ideas for informing and inspiring ecological theology, environmental ethics, and grassroots activism.

Religions are now reclaiming and reconstructing these powerful religious attitudes, practices, and values toward reconceiving mutually enhancing human-Earth relations. The resources of religious traditions can be brought forward in coherent and convincing ways in response to particular aspects of our current environmental crisis. This requires a self-reflexive yet creative approach to retrieving and reclaiming texts and traditions, reevaluating and reexamining what will be most efficacious, and thus restoring and reconstructing religious traditions in a creative postmodern world. All of this involves a major effort to evoke the power and potential of religious traditions to function even more effectively as sources of spiritual inspiration, moral transformation, and sustainable communities in the midst of the environmental challenges faced by the Earth community.

World religions are seen as providing a broad orientation to the cosmos and human roles in it. Attitudes toward nature thus have been significantly, although not exclusively, shaped by religious views for millennia in cultures around the globe.

In this context, then, religions can be understood in their largest sense as a means whereby humans, recognizing the limitations of phenomenal reality, undertake specific practices to effect self-transformation and community cohesion within a cosmological context.

Religions thus refer to those cosmological stories, symbol systems, ritual practices, ethical norms, historical processes, and institutional structures that transmit a view of the human as embedded in a world of meaning and responsibility, transformation and celebration. Religions connect humans with a divine presence or numinous force. They bond human communities and they assist in forging intimate relations with the broader Earth community. In summary, religions link humans to the larger matrix of indeterminacy and mystery from which life arises, unfolds, and flourishes.

Institutions and Worldviews

Certain distinctions need to be made here between the particularized expressions of religion identified with institutional or denominational forms of religion and those broader worldviews that animate such expressions. By worldviews we mean those ways of knowing, embedded in symbols and stories, which find lived expressions, consciously and unconsciously in the life of particular cultures. In this sense, worldviews arise from and are formed by human interactions with natural systems or ecologies. Consequently, one of the principal concerns of religions in many communities is to describe in story form the emergence of the local geography as a realm of the sacred. The exploration of worldviews as they are both constructed and lived by religious communities reveals formative attitudes regarding nature, habitat, and our place in the world.

A culture's worldviews are contained in religious cosmologies and expressed through rituals and symbols. Religious cosmologies describe the experience of origination and change in relation to the natural world. Religious rituals and symbols arise out of cosmologies and are grounded in the dynamics of nature. They provide rich resources for encouraging spiritual and ethical transformation in human life. This is true for example in Buddhism, which sees change in nature and the cosmos as a potential source of suffering for the human. Confucianism and Daoism, on the other hand, affirm nature's changes as the source of the Dao. In addition, the death-rebirth cycle of nature serves as an inspiring mirror for human life, especially in the Western monotheistic traditions of Judaism, Christianity, and Islam. All religions translate natural cycles into rich tapestries of interpretive meanings that encourage humans to move beyond tragedy, suffering, and despair. Human struggles expressed in religious symbolism find their way into a culture's art, music, and literature. By linking human life and patterns of nature, religions have provided a meaningful orientation to life's continuity as well as to human diminishment and death. In addition, religions have helped to celebrate the gifts of nature such as air, water, and food that sustain life.

Religions have been significant catalysts for humans in coping with change and transcending suffering while at the same time grounding humans in nature's rhythms and Earth's abundance. The creative tensions between humans seeking to transcend this world and yearning to be embedded in this world are part of the dynamics of world religions. Christianity, for example, holds the

promise of salvation in the next life as well as celebration of the incarnation of Christ as a human in the world. Similarly, Hinduism holds up a goal of *moksha*, of liberation from the world of *samsara*, while also highlighting the ideal of Krishna acting in the world.

This realization of creative tensions leads to a more balanced understanding of the possibilities and limitations of religions regarding environmental concerns. Many religions retain otherworldly orientations toward personal salvation outside this world; at the same time they can and have fostered commitments to social justice, peace and ecological integrity in the world. A key component that has been missing in much environmental discourse is how to identify and tap into the cosmologies, symbols, rituals, and ethics that inspire changes of attitudes and actions for creating a sustainable future within this world.

In alignment with these concerns for "eco-justice," religions can encourage values and ethics of reverence, respect, restraint, redistribution, responsibility, and renewal for formulating a broader environmental ethics that includes humans, ecosystems, and other species. With the help of religions humans are now advocating for a reverence for the Earth and its long evolutionary unfolding, respect for the myriad species who share the planet with us, restraint in the use of natural resources on which all life depends, equitable distribution of wealth, recognition of responsibility of humans for the continuity of life into future generations, and renewal of the energies for the great work of building a sustainable Earth community. These are the virtues for sustainability, which the world's religions can contribute.

Response of Leaders and Religions to the Environmental Crisis

In recent years there has been a growing call from various groups, from environmental organizations to scientists and parliamentarians, for the world's religious leaders to respond to the environmental crisis and play an active role in the development of a more sustainable planetary future. In addition, there has been a striking growth in monographs and journal articles in the area of religion and ecology, while several national and international meetings have also been held on this subject. The World Wildlife Fund (WWF) has sponsored interreligious meetings, the United Nations

Environment Programme (UNEP) has established an annual Environmental Sabbath, the Parliament of World Religions, held most recently in Salt Lake in 2015 also had a major focus on the role of religions in contributing to a sustainable future.

International meetings on the environment such as the Global Forum of Spiritual and Parliamentary Leaders have been held in Oxford (1988), Moscow (1990), Rio (1992), and Kyoto (1993). These included religious leaders such as the Dalai Lama as well as diplomats and heads of state such as Mikhail Gorbachev. Moreover, the Tehran Seminar on Environment, Culture, and Religion was held in Iran in June 2001 and one on “Environment, Peace and the Dialogue of Civilizations and Cultures” was organized in May 2005 with the second one in April 2016. All of these were sponsored by the Iranian government with the support of the United Nations Environment Programme. Gorbachev has held several Earth Dialogues on “Globalization: Is Ethics the Missing Link?” held in Lyon, France in 2002, in Barcelona, Spain in 2004, and in Brisbane, Australia in 2006. The International Union for the Conservation (IUCN) organized the first panel on “Spirituality and Conservation” at the World Conservation Congress in Barcelona in 2009 and had a major track on this topic at their conference in Hawaii in September 2016.

Since 1995 the Ecumenical Patriarch Bartholomew has convened symposia on “Religion, Science, and the Environment” focused on water issues in Europe, the Amazon, and the Arctic. Similarly, the Alliance of Religions and Conservation (ARC) based in England has been convening conferences and activating religious communities for some twenty years. In the United States, the National Religious Partnership for the Environment (NRPE) has organized the Jewish and Christian communities on this issue. The time is thus propitious for encouraging the contributions of particular religions to solving the ecological crisis, especially by developing a more comprehensive environmental ethics to ground movements focused on sustainability.

One of the most significant contributions to this work is the encyclical by Pope Francis, *Laudato si'*. Here the focus on integral ecology is one that brings together social justice and environmental protection. The Pope issues a comprehensive call for creating the conditions for genuine sustainable development. With a strong critique of unrestrained capitalism and unlimited growth he calls for a new economics that links equity and the environment.

The Need for Interdisciplinary Dialogue

Religions have a central role in the formulation of worldviews that orient us to the natural world and the articulation of ethics that guide human behavior. The size and complexity of the problems we face require collaborative efforts both among the religions and in dialogue with other key domains of human endeavor. Religions, thus, need to be in conversation with key sectors—science, economics, education, and public policy—that have addressed environmental issues. Environmental changes will be motivated by these disciplines in very specific ways: namely, scientific analysis will be critical to understanding nature’s economy, economic incentives will be central to adequate distribution of resources, educational awareness will be indispensable to creating modes of sustainable life, public policy recommendations will be invaluable in shaping national and international priorities, and moral and spiritual values will be crucial for the transformations required for life in an ecological age.

Thomas Berry observed that assisting humans by degrading the natural world cannot lead to a sustainable community. The only sustainable community is one that fits the human economy into the ever-renewing economy of the planet. The human system, in its every aspect, is a subsystem of the Earth system, whether we are speaking of economics, physical wellbeing or rules of law. In essence, human flourishing and planetary prosperity are intimately linked.

Notes

1. The word “anthropocosmic” is used by Tu Weiming in *Confucian Thought: Selfhood as Creative Transformation*. Albany: State University of New York, 1985.

Quality of Government and Sustainable Development

Víctor Lapuente

If the sustainability of the planet depends on the action of human beings, good government of human beings ought therefore to be crucial for sustainability. However, only recently has good government started to be considered fundamental for ensuring environmental sustainability. I propose here to summarize the studies which have tried to show the effect that good government of the public sphere has on the environment. Which governments are best for achieving sustainable development?

I shall concentrate on two aspects. The first is the hardware of good government, which we know as “governance,” “state capacity” or “quality of government.” Regardless of the label, the hardware of good government refers to those public institutions which act with impartiality, not favoring the private interests of anyone who offers bribes or has connections to a political party, or because of their skin color or the language they speak. Countries with impartial public institutions are able to adopt better policies of sustainability, and to implement them efficiently afterwards. But every hardware needs its software. Good institutions should house good decision-makers, with politicians who apply a philosophy appropriate to sustainability. By “philosophy” I do not mean an ideology, although I do not deny that ideology may play an important role. The philosophy I am referring to is something deeper that flows beneath ideologies: how far do politicians dare to explore new approaches to sustainability without prejudice? Unlike the hardware, for which we have relatively precise measurements of the effects it has on sustainability, the effects of the software are harder to calibrate. However, I would like to stress how important it is that politicians should be open to experimentation, to testing measures that depart from their ideological scripts, when it comes to policies of sustainability.

Let us begin with the hardware, the quality of government. The wave of research which has explored the consequences of impartial institutions over the last two decades has also reached the shore of sustainable development. The twenty-first century has witnessed a growing concern with the governmental characteristics that most critically affect the capacity to achieve sustainable development.

The first lesson, but perhaps not the most important, is that democracy matters. Democracy is the first aspect of a government we consider. Are the leaders of the country chosen by means of elections? (And, it should be added, elections that are free and fair, since polls are organized by most countries today, but many continue to be marketing operations rather than competitive exercises.)

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This is most certainly important, as was already indicated by the pioneering researchers into the effects of institutions on sustainability. In comparison with dictators, democratically elected governments have a broader temporal horizon. Parties in government are worried about long-term problems, like sustainability. Dictators, on the other hand (with some exceptions like Singapore and other rare examples of the phenomenon known as “developmental dictatorships”) generally worry about today, scorning a tomorrow when they do not know if they will still be in power. Authoritarian leaders are especially unconcerned with sustainable development if they, their families and their closest supporters control major sectors of the economy, a very habitual phenomenon. Dictators will give precedence to the extraction of profits from these sectors, often related to natural resources and polluting technologies, over sustainable and inclusive development. Their development is, by definition, exclusive.

And there is evidence that democracy helps sustainable development. Observation of other factors shows us that democracies reduce emissions of CFCs and sulfur oxide, and with them levels of pollution; they are more inclined to adopt national legislation in support of international treaties like the Montreal Protocol; they were the quickest to ratify the United Nations framework agreement on climate change; and they protect a larger percentage of forest cover. The more democratic your country is, meaning the more competitive and less fraudulent its elections are, the greater the probabilities of achieving sustainable development.

Two important provisos must be mentioned here. In the first place, not all democratic régimes have the same balsamic effect on sustainable development. Parliamentary democracies generate policies that are more respectful to the environment, but presidentialist régimes often adopt policies as lax as those of dictatorships. For example, parliamentary groups, whether of a single color or multi-party coalitions, have a greater capacity to raise taxes on fossil fuels than executives in presidentialist systems, who have to negotiate with a potentially hostile legislature. The snag, obviously, is that the scope for governmental abuse, or even the undue appropriation of funds, is greater in parliamentary systems. For a parliamentary democracy to commit itself to sustainable development, then, formal and informal controls over the government must be effective.

The second proviso is that the electoral system itself may also have an influence. In majority election systems, such

as the first-past-the-post constituencies of countries with an Anglo-Saxon tradition, parties tend to concentrate their efforts on key districts, with more sensitivity to local issues than to the general interest. Lobbies that represent specific industries are more influential in majority election systems, and so are able to obtain less stringent environmental rulings than in proportional representation systems. Having said this, studies indicate that even though a proportional system may have advantages over a majority one, the really important thing is that there should be free and competitive elections. Where there is a genuine democracy, regardless of whether we vote for a candidate in a particular constituency or for a party in general, there are more likely to be policies aimed at achieving a sustainable development.

If we examine comparative indices of sustainability, it becomes clear that democracies, and above all parliamentary democracies, favor sustainable development. For example, the indices of sustainability or environmental action are invariably headed by long-established democracies like Switzerland, Finland, Sweden, Germany or Australia, and some newer but consolidated ones like Spain and Portugal. However, a growing number of researchers stress that while democracy is necessary, it is rarely sufficient in itself to explain the implementation of policies for sustainable development. Something else is needed.

What is necessary is that a country's institutions should act impartially and incorruptibly. This is perhaps the key to understanding the differences between countries when it comes to fomenting sustainable development: how corrupt are the politicians and civil servants? Study after study shows that after controlling all kinds of factors linked to polluting emissions, the latter still increase drastically with a country's levels of corruption. Corruption raises the emissions per capita of carbon dioxide, sulfur oxide and other air pollutants. There are various mechanisms through which corruption harms environmental sustainability. First of all, corrupt politicians in permissive legislations are more liable to allow themselves to be persuaded by interest groups. Second, the implementation of environmental legislation is much more relaxed, or non-existent, in places where public employees are ready to take bribes, or, as occurs in many countries, where they demand a cut in advance in return for looking the other way during environmental inspections. In the case of Southeast Asia, it is well known that entrepreneurs often find it cheaper to buy off officials than to comply with environmental regulations.

The more democratic the country, the greater the probabilities of it achieving sustainable development

Corruption also has two important indirect effects on the environment. The first is that an absence of corruption moderates the negative effect of the shadow economy on levels of pollution. This is not a minor issue, since the shadow economy represents around a third of world GDP and rises above 50 per cent in many emerging nations, which suffer especially from degradation of the environment. Moreover, the underground economy, from leather tanning to urban transport and illegal factories, spreads particularly in activities with a high potential for pollution. Traditionally, studies had concentrated on the dire environmental consequences of the shadow economy, such as the adaptation of propane among illegal brick manufacturers in Mexico. However, recent publications have broadened the focus by pointing out that the effect in question depends crucially upon the level of corruption of the public administrations. When the entrepreneurs of the black economy are faced with public officials ready to take bribes, they are able to ignore environmental regulations. By contrast, an honest public administration minimizes the negative effects of the shadow economy as regards corruption. This has important consequences for the design of public policies, above all in emerging countries. While we cannot put a stop to the black economy all at once (although the goal is a worthy one, and achievable in the medium term), we ought to focus our efforts on the prevention of administrative corruption.

The second indirect effect of corruption upon sustainable development is produced through foreign investment or commercial liberalization; in other words, through globalization. The level of corruption limits the effects that opening up a country's borders has on its sustainable development. If corruption is low, globalization has a positive effect on sustainability. The arrival of foreign capital leads governments to adopt policies that are more respectful to the environment. On the contrary, if the level of corruption is high, foreign investment has negative instead of positive effects. Governments, willing to sell legislation to the highest bidder, pass laws that are detrimental to sustainability. The consequences of these results go further than policies of sustainability. If we wish to understand why globalization is so poorly regarded in some countries, we should look at the level of corruption they possess.

All this is especially important if we bear in mind that levels of corruption vary dramatically among countries. This is true even in the context of capitalist democracies, where one might expect fewer differences. In the European Union, for instance, we find some of the least corrupt countries in the world according to every indicator,

such as the Nordic countries, together with some nations that rank lower than eightieth or ninetieth in the world. Some of the latter are ex-Communist nations, like Romania or Bulgaria, but others, like Italy and Greece, are culturally closer to us. Besides, if there is one thing we have learned by studying corruption in recent years, it is that there is no reason why levels of corruption should be on the descent, even in democracies. As we are shown by the experience of Latin America in the twentieth century, and by some transitions to democracy in recent decades in both Europe and Asia, corruption can easily end up living side by side with regular elections. Votes do not flush corrupt politicians or civil servants out of public institutions. On occasions, corruption is a mechanism for remaining in power by distributing favors.

The positive note is that corruption can be ended, unlike other factors affecting sustainability such as a country's level of socioeconomic development or its cultural values. However, a great deal of political determination is necessary, and social pressure is needed from both civil and entrepreneurial organizations in denouncing the harmful effects of corruption on sustainable development. But is it possible to minimize opportunities for corruption in a country? And how is this to be done?

Fortunately, more and more evidence is reaching us every day of the kind of reforms that are effective in reducing levels of corruption. In general, measures to prevent corruption work better than measures to punish it, such as tougher penalties or the establishment of anticorruption agencies and other organizations devoted exclusively to fight against fraudulent activities. The preventive measures which reduce corruption most effectively are those which insert automatic control mechanisms in public decision-making. The first of these is transparency. This is not total transparency, which could have harmful consequences, but a reasonable amount of transparency which would permit access to information on public decision-making (environmental reports spring to mind), with few restrictions on interested parties, such as journalists and activists. The second measure is to establish public decision-making systems in which people with different interests, such as politicians who owe themselves to their party or civil servants who owe themselves to their reputation (and not to political favors), have to reach decisions jointly. In this way, some exert control over others and vice versa. The effects on corruption of such systems of "separation of politics and administration" are very substantial. Moreover, they are not costly in economic terms, though in political terms they might be.

Following on from this, I should like to add a final reflection on the importance of the software, the will of the politicians, in producing a good government committed to sustainable development. Let us take a specific example. Traffic congestion charges are paid by the inhabitants of Gothenburg, Stockholm, Oslo, London and other cities, though the number of such cities overall remains small. Extremely small, in fact, if we bear in mind the growing urban concentration of the world's population. As experts generally say (and there are some first-class ones in Spain, such as Daniel Albalade and Germà Bel), the level of consensus among economists on the benefits of a congestion charge is inversely proportional to its acceptance among the public and the politicians.

How to win greater acceptance for policies of sustainability that are at first sight unpopular? And how to encourage other sustainable policies, such as partially replacing motor traffic with bicycles in city centers, which may also spark resistance? I think the experience of the Nordic countries is illustrative of the political philosophy, the software, which has to feed public action. Parties owe themselves to their voters and to their ideologies as political organizations. This is quite true, but so too is the fact that governing with a rear view mirror, looking back at what yesterday's voters wanted instead of worrying about collective welfare in the future, torpedoes innovation.

If there is one thing policies of sustainability need, it is innovation. And to innovate, one must be open to different options. If the Nordic conservative parties had been excessively concerned with satisfying the interests of their voters in the residential suburbs, they would not have supported the introduction of congestion charges. A similar point may be made of the social democrats. Even in a city like Gothenburg, which revolves around its car industry, they managed to conquer historic inertia and ideological resistance in order to oppose a congestion charge that affected most the drivers with least resources.

Policies that favor sustainability need to break away from ideological restrictions and from a "stethoscope" politics constructed on the basis of opinion polls. They need to incorporate a wider range of players, such as experts and representatives of civil society. And they need to experiment. The results of a public policy in a phenomenon as complex as sustainability, with its confluence of so many unpredictable factors ranging from the climate to the economy, cannot be known until it has been implemented. Sustainable development demands that we risk making mistakes.

The Great Challenge for Intermediary Cities

Firdaous Oussidhoum

The urban world is posing a challenge for the sustainability of the planet. Its inhabitants' comfort, quality of life and levels of consumption, together with the need for large numbers of quality dwellings owing to migrations from rural areas or other countries, have made that world a place where resources are consumed, and where strategic planning and the use and reuse of resources, without abusing them, has become an obligation. There is talk today of a circular economy for cities, of green buildings, of renewable and/or clean energies, and other concepts. In reality, these are all part of the same quest for solutions in an attempt to prevent further abuse of the planet's resources, and to offer our children an opportunity to build their sustainability, since the two-degree temperature rise we are so arduously negotiating today is in actual fact too high, and has come too late.

In the middle of this landscape are cities, viewed in terms of their mode of management, mode of living, mode of production, and mode of telling everyday human stories.

It is precisely in everyday life that the vital moment now unfolding is most relevant. Several global agencies and institutions are being set up to align and generate a global and planetary vision in which all countries will be involved and in agreement. The New Urban Agenda, the decisions of the COP regarding a new climate agenda, the disaster risk agenda, and other similar initiatives currently taking shape call for local action in order to be realized, necessarily involving local governments but above all requiring increased awareness and participation from all city dwellers on the planet. The answer has to be global because the issue is one that affects all of us in our daily life.

Territorial and urban policies define our everyday life. Cities therefore represent a voice which world institutions can no longer ignore when it comes to negotiating global agreements, owing on the one hand to the national and international importance acquired by certain metropolises, and on the other to the social, economic and safety challenges faced by cities. However, the challenge of the future lies not with metropolises but with intermediary cities. A third of the urban population currently lives in intermediary cities, another third in metropolises, and the final third in rural zones and territories.

Intermediary cities are a key piece, if not a unique one, in achieving sustainability for the planet. There are several reasons for this.

Secretary general of the Global Forum of Intermediary Cities of the United Cities and Local Governments (UCLG) corporation of the UNESCO Chair in Intermediary Cities: Urbanization and Development and director of international relations of the African Union of Architects

The Figures

According to studies carried out by the UNESCO Chair in Intermediary Cities and World Urbanization in collaboration with UCLG (United Cities and Local Governments), it is estimated that by 2030 half of the world's urban population will live in intermediary cities (or i-cities).¹ That number is expected to increase to 70 percent by 2050.

For that very reason, the importance of cities in the dynamics of world sustainability seems self-evident, and intermediary cities are the emerging strategic force in this scenario. This projection clearly proposes a panoramic image of the planet in terms of urban development for the future, and intermediary cities are crucial in this context for the world's sustainability. Indeed, as far as the urban world is concerned, the planet's sustainability will largely depend on the evolution of intermediary cities.

What Are Intermediary Cities?

Intermediary (or intermediate) cities are cities that play a role of intermediation in their regional and/or national territories, with a potential for intermediary dialogue in their national or regional systems between the forces governing the territory, whether political, economic, environmental, cultural, social and/or human. While generally defined by the number of inhabitants (between 20,000 and 1 million), i-cities are distinguished more by the relationship generated with their urban environment and by the concept of intermediation they embrace in order to generate development.

This definition is also applicable to China, a context where an intermediary city can have around five million inhabitants. Indeed, it is expected that by 2030 75 percent of the Chinese population will belong to the middle class. This raises some very serious issues. Middle-class living entails more cars, more air conditioning, more comfort, and more resources to consume. Where will those resources come from, when China is already seeking them in Africa? This shows the issue to be a planetary one that concerns each and every one of us.

Last year, a crucial one for world urban development with the launching of the UN-Habitat's New Urban Agenda, intermediary cities have been able to make their voice heard and develop an agenda of their own in response to the willingness of their leaders to collaborate in the sustainability of the planet.

The added value of intermediary cities for the Habitat III agenda has been defined in the following terms: Intermediary cities are a new paradigm in itself that needs its own agenda. Through i-cities, a voice can make itself heard for the population represented by local governments, for the territories and their resources, and for a new path to sustainability on a global scale. Intermediary cities must have their own voice in discussions on cities and urban development. Intermediary cities must have their own agenda for implementation. This is a great responsibility for both decision-makers and citizens, and it points to a central role for those who take local decisions in urban and territorial policies and affairs.

I-cities therefore offer a unique opportunity to develop planetary sustainability based on a consensus between the decision-makers and the citizenry, a key element in the implementation of the New Urban Agenda.

Sustainability Linked to Democracy

Cities are an expression of the type of local democracy that combines the democratic identity of a country with the specificities of its processes. This expression requires a democratic dialogue between the decentralized systems within said country. I-cities thus also become a force of urban democracy, both at a local and national level.

Since intermediary cities are the meeting point between the rural and urban worlds, they provide an opportunity to generate a civic and democratic space that large cities or metropolises can no longer permit themselves so easily, owing to their pace of life (and its management) and growth. In this way, cities become a place in which democracy and cohesion can find expression in an urban setting. This opportunity for safe and cohesive management is offered through an urban democracy that offers secure institutional channels of expression. I-cities, with their advantage of proximity and their potential for urban management, make it possible to give serene and pedagogical consideration to matters such as questions of gender (especially on public transport), the participation of citizens in the city's life and decision-making, and other key aspects of issues currently affecting us.

The concept of urban democracy is made easier by a city that has proximity as one of its defining factors. The participation and involvement of citizens is essential for the implementation of urban policies stemming from the international recommendations of the Sustainable Development Goals (SDG).

In the same way, i-cities are a necessary element for the implementation of the SDG through global agendas, for three specific reasons:

- 1) The implementation of global agendas will have to pass through the local level, whether the focus is on projects, raising awareness among the population, management, or finance.
- 2) They represent the largest urban area where agendas can be applied, offering a greater geographical urban impact.
- 3) Since they are an element of dialogue within the territory, both in terms of vertical governance and in terms of proximity to citizens and the rural world, intermediary cities make policy implementation possible in large territories, resulting on a greater impact on the natural environment with a view to its sustainability.

Dialogue, the Essential Strength of Intermediary Cities

One of the greatest strengths of intermediary cities is their potential for dialogue on the levels of geography, governance, territory and population. Intermediary cities must boost dialogue if full advantage is to be taken of their potential for human development.

Space materializes this potential for dialogue. At the territorial level, intermediary cities are by definition an element of dialogue. Until now it has been a stage in migration from the countryside to the metropolis, where opportunities are sought for work and personal and family development. Today's metropolis is looking for solutions that will allow it to enter a logic of sustainability, such as the concept of the smart city, an experiment that started with the integration of numerical technology into the management of the city and that is finally focusing and materializing around the notion of a "more human city." The human factor, the human scale and proximity are part of the essence of the intermediary city.

In this respect, India, with its capacity, potential and youth in terms of information technology and numeracy, is developing a smart city program for its intermediary cities. It has understood on the one hand that its metropolises cannot hold a larger population, since this will generate more poverty and inequality, and on the other that the smart city experiment is naturally applicable in i-cities. It is also hoped that people will become more aware of the

priorities of sustainability through information technology systems and through the mobilization of human resources.

"The intermediary city is the solution to the metropolis," said the minister of Housing and Sustainability of Costa Rica at the session of Habitat III devoted to i-cities in Quito in October 2016. This is becoming a reality under its own momentum. In view of the dynamics in the north of the world, where *Homo urbanus* is trying to approach nature once more and regain a more human environment, the sense of identity and belonging, and the quality of life enjoyed by *Homo ruralus*, reverse migrations are now occurring from the metropolis to more "livable" cities.

In this territorial dialogue, we must also pay attention to the rural environment. Intermediary cities can support small towns and villages, which in effect are the nursery of a culture in proximity to nature. The question is whether a dialogue can be generated to connect these different urban dimensions among themselves. In this regard, horizontal dialogue and city-to-city cooperation on the territorial level are urgently needed to open the door to sustainability. Territorial dialogue could (or should) materialize in a mastered and systemic management based on collaboration, with interconnected cities forming systems or constellations within more or less specific surrounding territories and natural environments. From an economic, cultural, social and ecologic point of view, these need to be managed in the context of knowledge of the territory, and this in turn requires a strategic vision that will value the existing territorial resources.

I-cities will thus be enabled to play their role to the full by their integration in the development of the territory that surrounds them. Human development and local economic development go together in a territory whose leadership is given value by the intermediary city. These rural links and connections allow the intermediary city to cover an urban and natural (rural) space within the framework of a horizontal dialogue, a development of particular importance for the implementation of the SDG and the New Urban Agenda.

Today, in fact, the approximately nine thousand existing intermediary cities cover the broadest geographical area on the planet. Surely this is a unique potential for the implementation of the global agendas on sustainability and climate change.

What is at stake in today's intermediary cities is urban sustainability for the viability of tomorrow's planet.

To fulfill this mission, a vertical dialogue is also required between various levels of governance, integrating the

various hierarchical levels into a single dialogue with a common interest: sustainability for all.

A Critical and Strategic Mass

The critical mass of these cities constitutes a key challenge for the cities of the Global South, and is fertile terrain for a dynamics of South–South and triangular cooperation, interchange of management and technical expertise, and development of local democracy and new experiences in local governance.

On the national level, intermediary cities can be a force for the proposal of national as well as international policies within the framework of a vertical dialogue, thus making them strategic partners.

Hence the need for organization and the importance of the working group, whose objective was spelled out by its chairman, Mohamed Sefiani, mayor of the city of Chefchaouen in Morocco: “To advance together toward the same goals in consensus for a more sustainable planet.”

The goal is still to bring integrated policies and the means to ensure their own sustainability to the citizens of the world and their leaders, with respect for their environment, culture and identity, on a worldwide scale.

Intermediary cities pose a key strategic challenge on a global level. They allow a wider band of the world’s population to be affected, they allow urban development to be accompanied by human development, and they allow the urban world to be given a dignified form that will accelerate in coming years in terms of equity, equality of opportunity, urban quality, democracy and expression, culture and identity, innovation and apprenticeship, within the framework of a professional, political and human dialogue.

There is much talk today of city rights—that is, rights of and to a city. In my view, it is in fact the human rights charters that have allowed us to construct the world so far. Now, in the twenty-first century, we have to go further, thinking and projecting a world of greater generosity, with cities that embrace and open themselves to their populations. When we speak of more human cities, we should be talking of what makes the strength of human beings: giving, receiving, and offering from the heart, with generosity. This “city attitude” already exists in many intermediary cities around the world, and needs to be generalized. That is why in the i-cities community we speak of “good living.”

With the vocabulary of “rights,” it is suggested that we request the natural and already-integrated “right to” a city. Citizens must also remember that they have responsibilities toward their natural environment, their living space, their city, their fellow citizens and their planet.

The implementation of these global agendas therefore has to pass through the local level, with the involvement of citizens as individuals and as groups. All of us are professionals, consumers, members of civil society, men or women, and each of us is trying to live better. That is why intermediary cities are of key importance in the implementation of the path to sustainability.

Making of this implementation a coherent planetary strategy is the next challenge.

Mohamed Sefiani, mayor of the city of Chefchaouen, Morocco

The urban world has understood the importance of intermediary cities: by 2030, 65 percent of urban development will be located in i-cities. This development represents a challenge in every dimension: economic, social, cultural, patrimonial and, above all, that relating to sustainability. It is important to raise awareness at national and international levels of the added value of facilitating, promoting and listening to the leaders of i-cities, since the challenge facing them is the same which faces us all.

In these crucial times, when world agendas are conceived globally and acted upon at a local level, answers must also be found for how the local can contribute from the bottom up to the global level, then returning to the local for effective implementation.

More than ever, coming together and forming a worldwide critical mass among those of us who lead intermediary cities is becoming a strategy to provide us with better conditions for responding to the needs of our citizens and assuming our responsibilities in the face of our planet’s challenges.

Notes

1. Within the framework of its scientific and political organs, UCLG, in partnership with the UNESCO Chair for Intermediary Cities and World Urbanization in the University of Lleida, has launched a global working group on intermediary cities, which since April 2014 has been chaired by the city of Chefchaouen (Morocco).

Gateway to India

Steve McCurry

Steve McCurry (United States, 1950) reveals his vocation as a documentary maker in his photographs of India, taken over the course of his nearly one hundred visits to the subcontinent. Bearing witness to the urban growth of recent decades, these geopolitical pieces use street scenes to summarize the challenges faced by overpopulated metropolises with contrasting extremes. These are cities bound for rapid change where an ancient history nonetheless persists.

Allahabad, India, 2001



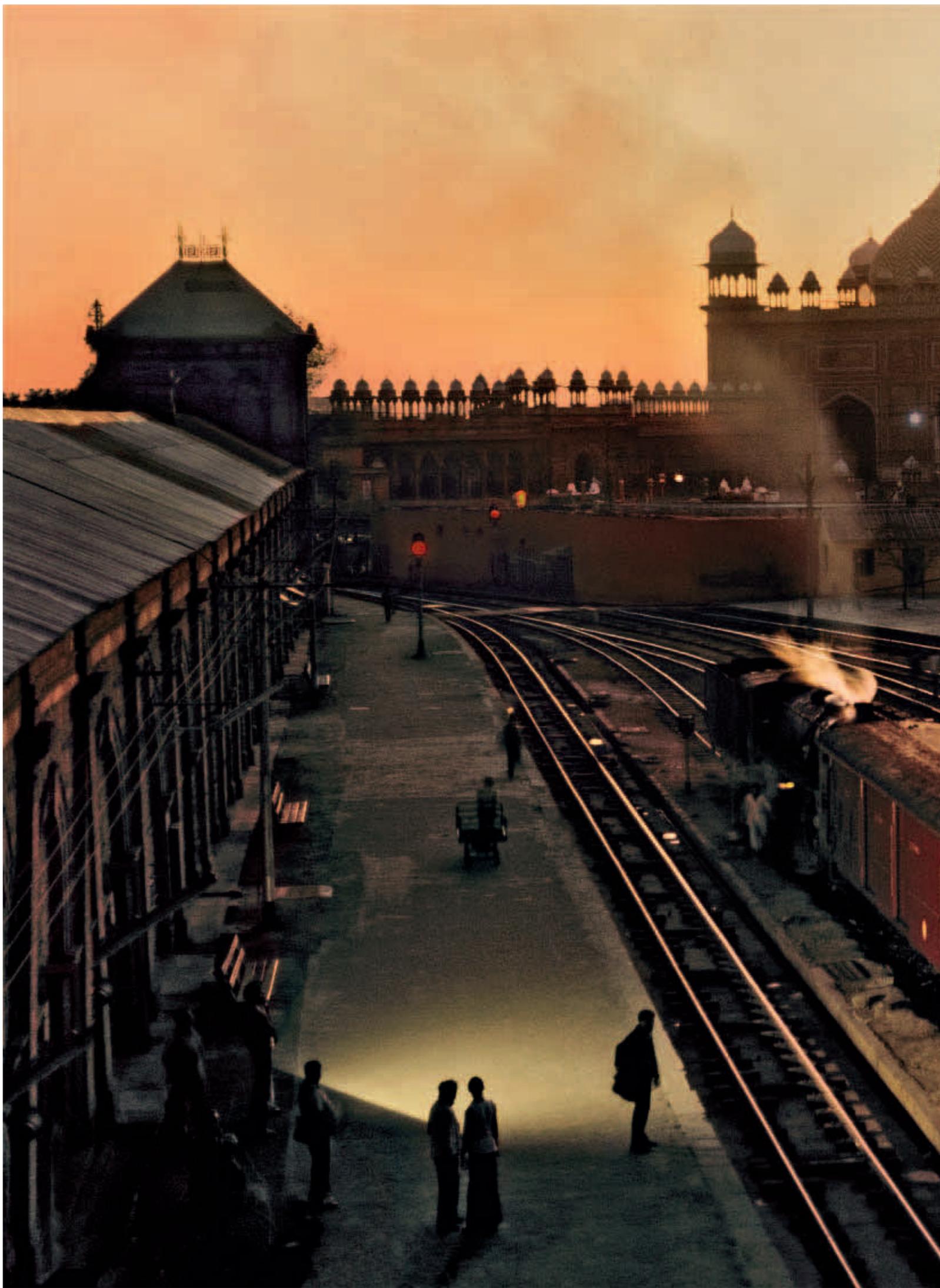


Calcutta, India, 1996





Fort train station, Agra, Uttar Pradesh, 1983





Moonrise in Mumbai, India, 1994





Mumbai, an Indian city at dusk, 1996





Much more is gained by improving procedures than by improving the people in charge of them. We should not expect so much of the virtues of those forming part of a complex system, nor should we greatly fear their vices. What should really concern us is whether their interconnection is well organized

Daniel Innerarity

7. *The Challenge of Transversality*

There are enough resources to satisfy global energy requirements in a sustainable way, but what is needed is a radical change in our policies

Domingo Jiménez Beltrán

We need to consider whether or not the gains in efficiency derived from these developments are leading to more livable and equitable urban environments

Michael Batty

The Government of Intelligent Systems

Daniel Innerarity

The main task of the government of a knowledge society is to create the conditions that will enable collective intelligence. Systematizing intelligence and governing through intelligent systems should be the priority at every level of governments, institutions and organizations. Governing complex environments, confronting risks, anticipating the future, managing uncertainty, guaranteeing sustainability and structuring responsibility oblige us to think holistically and to configure intelligent systems (technologies, procedures, rules, protocols, etc.). Only through such patterns of collective intelligence is it possible to face a future that is no longer the peaceful continuation of the past but an opaque reality full of opportunities, and by the same token pregnant with potential risks that are hard to identify. The same principle of intelligent government should rule the way we relate to our technological devices in order to face up to the new instances of ignorance that a complex society obliges us to manage.

The Nature of Collective Intelligence

To understand what a system of collective intelligence is, it may be illustrative to recall the mental experiment proposed by Robert Geyer and Samir Rihani (2010, 188): 1. What would happen if the governors of the Bank of England were replaced by a room full of monkeys? 2. What would happen if Great Britain were to copy Norway's educational system exactly? 3. What would happen if a super-medicine were invented that suppressed all the symptoms of the common cold (or of our students' hangovers)? If one had to respond quickly to these questions, immediate intuition would lead to the following assertions: 1. The British economy would collapse. 2. Educational results would improve, since Norway's educational system is far better ranked than the United Kingdom's. 3. It would be a marvelous advance for personal health, since the patient would feel much better. However, as soon as we are able to reflect a little and overcome the automatism of these answers, looking at things instead from the perspective of the complexity of systems, the answers start to look very different. 1. The government of monkeys would make manifest exactly to what point we are governed more by systems than by people, with checks, balances and counterbalances, and so the monkeys would do less harm than might be supposed. 2. The transfer of an educational system to another country would not be as successful as all that. There is of course much to be learned from the best practices of others, but the success of a system as complex as education depends a great deal on factors that are not

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automatically transplantable. 3. Being healthy is not the same thing as feeling well, and removing bothersome symptoms is equivalent to depriving oneself of signals and learning mechanisms that are precisely at the service of our health, understood as something more valuable than a mere absence of ill-being at any given moment.

This experiment is interesting because the automatism of our initial responses shows how indebted we are to a way of thinking centered on individuals and leaders, on the short term and on a lack of attention to the systemic conditions in which our actions take place. We still think of government as a heroic action by individuals instead of understanding that it is a matter of configuring intelligent systems. This is a proof of what Luhmann called “the flight toward the subject” (1997, 1016), when political action degrades into a competition among persons, their programs, their good (or bad) intentions or their moral example. That is why we speak of leadership with such personalized connotations. Public attention is concerned principally with the personal qualities of those who govern us, and we are more worried about discovering guilty parties than about repairing poor structural designs.

Any attempt to place the focus on human beings when identifying and confronting our problems, based on the theory that the human being is more important than anything else from the perspective of either the personal properties of the leader or the rational choice of the individual voter, brings with it an undervaluation of the systemic properties of social complexity. The main problems humanity faces today are conflicts engendered by an interdependent and concatenated system, ones to which its individual components are blind: unsustainability, financial risk, and those problems in general caused by a long chain of individual behaviors that are not detrimental in themselves, but are in disordered aggregate. It is therefore not so much a question of modifying individual behaviors as of configuring their interaction properly, and that is precisely the task which goes by the name of collective intelligence. Much more is gained by improving procedures than by improving the people in charge of them. We should not expect so much of the virtues of those forming part of a complex system, nor should we greatly fear their vices. What should really concern us is whether their interconnection is well organized, and what kinds of rules, processes and structures configure that interdependence.

Societies are well governed when it is systems synthesizing a collective intelligence (rules, norms and

procedures) that govern them, not when they have especially able people leading them. We could make do without intelligent people, but not without intelligent systems, or, as it is otherwise generally put, a society is well governed when it stands up to periods under bad governors. These two hundred years of democracy have configured precisely an institutional constellation in which a set of experiences has crystallized into structures, processes and rules (especially constitutions) that provide democracy with a high degree of systemic intelligence, an intelligence which is not in individuals but in the components constituting the system. In a way, this makes the democratic system independent of the specific people who act in it, and even of those who direct it, and so resistant to the faults and weaknesses of individual players. That is why democracy must be considered as something which functions with the average voter and politician, for it survives only if the very intelligence of the system compensates for the mediocrity of the players, including the chance arrival of a government of monkeys.

The Double Risk of Technologies

One example of the configuration of our collective intelligence is to be seen in the way we design our technological artifacts. I am referring less to their sophistication than to how we identify their future risks and protect ourselves from them. Now, one of the paradoxes of our technologies is that they have to contend with two contradictory risks: the risk they will cease to heed those who direct them, and the risk they will heed them too much. To go by this distinction, some accidents would therefore be due to impotence and others to omnipotence. We are more anxious about the latter than the former. It is more disturbing to be at the mercy of men than of machines.

The first type of risk is more evident. Complex systems usually function automatically, since we could have no sophisticated technology otherwise, but this autonomy often comes at the price of ungovernability, when the very systems we have configured escape from our hands and hurtle against us. World literature is plagued with fantasies, some highly realistic, of creations that acquire a life of their own and rebel against their makers, from Faustus and Frankenstein to the general characterization of today's world as one flying out of control (Giddens 1999). When we consider the specific problems of contemporary society, we find a great many examples of this lack of control, perhaps the most devastating being

Systems of government, from the most modest technology to the most sophisticated political proceedings, are more intelligent insofar as they can resist the obstinacy of those who govern

the difficulty of governing financial markets. When, for example, we affirm that something is not sustainable, we are saying that we were able to start it functioning, but we are not able to guarantee that it will function in future in accordance with the intentions that justified its implantation. In short, it could collapse. For an everyday example, we might also consider to what point our relations with the technology we use have been modified. We have grown accustomed to using devices whose logic we are ignorant of, and so hardly anyone now knows how they work, or is able to mend them. Even the specialist we turn to replaces parts rather than performing repairs. When something goes wrong, it does so irreparably.

The automatic pilot is a very good example of the paradox that emerges when we ask ourselves who is in charge around here. A pilot thinks he flies planes, but from this point of view, the truth is just the opposite. The pilot starts up the system, but it is immediately thereafter the machine which prescribes the pilot's actions to the smallest detail until finally doing without him altogether. The pilot has to adapt to the logic of the flight. A system is intelligent when it can even disobey certain absurd orders. Nobody in their right mind would disagree with this, since it provides us with an enormous number of devices that make our lives easier and sometimes literally safer.

The other great risk is that technologies will be excessively subject to the control of those who run them. There are accidents and catastrophes that are caused by an excess of power held by those running a technological system, not a lack of it. One thinks of railway accidents due to excess speed in which no device prevented the driver from surpassing the critical limit, as in the train crash of Angrois on July 24, 2013. The most dramatic case was that of the suicidal Germanwings pilot who crashed a plane into the French Alps on March 24, 2015. In both cases, the disaster was caused by the excessive power of a man over an artifact that was insufficiently intelligent, since it allowed the individual in charge free rein over the speed of the vehicle or even the liberty to crash it into a mountainside, with all the alarms going off but no device obliging him to rectify his course. There are many systems that are intelligent because they are able to oppose the express will of those running them. The sophistication of governing devices is brought about through systems that prevent governors from doing what they like, from constitutional limits in politics to automatic braking systems for car drivers.

I shall put this somewhat provocatively: the paradox of any intelligent system is that it does not permit us to do

whatever we want. Let us take a few examples. What a constitution principally resembles is a set of prohibitions and restrictions. It even makes itself hard to modify, laying down conditions for procedures and qualified majorities in order to guarantee that no such changes will be implemented on a whim or sanctioned by only a very small majority. The ABS brake system prevents us in a moment of panic from braking as much as we want to, which would endanger the stability of the car and end up doing us more harm than not braking. Even fear is an instinct that protects us from ourselves. In this respect, we might recall the story of the patient suffering from brain damage that prevented him from experiencing certain emotions such as fear. This allowed him to do some things better than other people, such as driving on icy roads, since he avoided the natural reaction of braking when the car skidded (Damasio 2008, 193). Anyone is free to buy all the financial products they want (and can, of course), but the experience of the economic crisis has made us establish more exacting conditions for purchasing them, obliging the credit institutions to ensure that those who buy them have the necessary solvency and knowledge to acquire a product that is not free of risk. In some way, systemic intelligence has configured a series of protocols so that people cannot do as they please when there are especially dangerous artifacts involved, whether a vehicle or a financial product. Indeed, there is a flourishing market in what we might without exaggeration call “the protection of people against themselves,” such as the “behavioral apps” which advise, urge and monitor us. Human beings do not always wish to do as they desire, and such self-restriction is a source of reasonable forms of behavior.

We can therefore say without fear of contradiction that systems of government, from the most modest technology to the most sophisticated political proceedings, are more intelligent insofar as they can resist the obstinacy of those who govern. That is what Adam Smith, Karl Marx and others tried to teach us: that social systems have their own dynamic which acts independently of the will of individual players. All of human progress is at stake in that difficult balance between permitting the human will to govern events and at the same time preventing arbitrariness.

The Germanwings crash perhaps occurred because this reflection on the dangers of those in charge of a technological device had disappeared from view as a consequence of the defense against terrorism, which tends to consider the enemy as someone located literally and metaphorically outside. It should be recalled that the

pilot flying the aircraft began his maneuver to crash into the Alps at a moment when he had been left on his own. Neither the other pilot nor the rest of the crew were able to get into the locked cockpit once the suicidal intentions became apparent. Our security protocols have been sophisticated since 9/11 with outside enemies in mind, not inside ones: an encroaching terrorist, not a mad pilot. That, among other reasons, is why it was possible to lock the aircraft’s cockpit from the inside, and why the door was armored. The whole paradox of the affair lies in how to cope with the risks presented by our own security measures, and how to avoid excessive protection.

An intelligent system is, so to speak, a system that protects us not only from others but also from ourselves. It is configured after the experience of the dangers we are capable of generating for ourselves, and against the atavism of considering that our worst enemy is someone different from ourselves. To act with this type of counter-intuitive intelligence, it is necessary to have realized, for example, that a society is not threatened so much by nuclear weapons in the power of an enemy as by its own nuclear power plants, and far less by the biological weapons of the enemy than by certain experiments of its own scientific system. It is not menaced by the invasion of foreign troops but by its own organized crime and the demand of its own drug addicts, and not by the famine and death caused by war but by the disabilities and death caused by its traffic accidents (Willke 2014, 60). What makes it most difficult for plural societies to decide their destinies freely is not so much an external impediment as a lack of agreement in their very heart. The solution does not lie with individuals, I would conclude, but in improving the systems that protect us against people and against our mistakes, our dementia and our evil.

An Enlightenment of Ignorance

In an intelligent system for the purpose of governing today’s complex environments, two fundamental experiences are crystallized. One is that knowledge is more important than norms, and the other is that what has to be managed is ignorance rather than knowledge.

Let us begin with the importance for governing of cognitive rulings. Government, when understood as something normative rather than cognitive, is too rigid, retrospective and slow to be effective in complex and dynamic knowledge societies. Apart from a normative perspective for simple and stable constellations, other knowledge-linked resources are also necessary, such as

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the expert knowledge that turns itself into rulings, the ability to argue and convince, and the possibility of collective learning. While the first Enlightenment revolved around the acquisition of knowledge for individual and social progress, the second Enlightenment should aim at a broader level of knowledge, at the intelligence of organizations and institutions, and at organized forms of collective intelligence. For organizations, constructing collective intelligence means that learning no longer takes place simply through evolution or mere adaptation, but must be systematically organized into sensible processes of knowledge management.

Just as decisive as the generation of knowledge, however, is understanding the function fulfilled by ignorance in a knowledge society, and why ignorance is important for the acquisition and reproduction of knowledge, as well as for the emergence and transformation of institutions. A knowledge society is one whose collective intelligence consists of prudently and rationally managing the ignorance in which we are obliged to act, which means in the last instance a society of *unknowledge*. We might put this less dramatically by affirming that it is a society where we have no option but to learn to go about things with incomplete knowledge. One fundamental aspect of collective ignorance is the question of "systemic ignorance" (Willke 2002, 29), when we refer to social risks, futures and constellations of players in which too many events are related to too many other events, so overwhelming individual players' capacity for taking decisions.

Whereas the dominant methods used to combat ignorance in other times consisted of trying to eliminate it, we may assume today that there is an irreducible dimension to ignorance, and we must therefore understand it, tolerate it and even make use of it and consider it as a resource (Smithson 1989; Wehling 2006). One example of this is the fact that the risk entailed in "trust in the knowledge of others" in a knowledge society has become a key issue (Krohn 2003, 99). The knowledge society may be characterized precisely as one which has to learn to manage this ignorance.

The limits between knowing and unknowing are not unquestionable, self-evident or stable. It remains an open question in many cases how much can still be known, what can no longer be known, and what will never be known. It is not the typical discourse of Kantian humility which confesses how little we know and how limited human knowledge is. It is even more imprecise than that "specified ignorance" of which Merton wrote. I am

referring to weak forms of knowledge, like something that is supposed or feared, of which it is not known precisely *what* is unknown and *up to what point*.

The appeal to *unknown unknowns*, which lie beyond scientifically established hypotheses of risks, has become a powerful and controversial argument in social debates on new research and technologies. Of course it is still important to broaden the horizons of expectation and relevance so as to be able to glimpse the unknown spaces we were previously unable to see, and so proceed towards the discovery of the “ignorance we are ignorant of.” But this aspiration should not make us fall into the illusory trap of believing that the problem of the unknown unknown can be resolved in the traditional way, which is to dissolve it completely for the sake of more and better knowledge. Even where the relevance of the unknown unknown has been expressly recognized, it is still not known *what* is unknown or *whether* there is anything decisive that is unknown. Knowledge societies must get used to the idea that they are always going to have to face the question of the unknown unknown, and that they will never be in a state to know whether and to what extent these unknown unknowns are relevant with regard to those confronted of necessity.

From now on, our great dilemmas are going to hinge on *decision-making under ignorance* (Collingridge 1980). Now, decision-making under ignorance requires new forms of justification, legitimization and observation of consequences. How can we protect ourselves against threats about which by definition we do not know what to do? And how can justice be done to the plurality of perceptions of the unknown if we are ignorant of the magnitude and relevance of what is not known? How much unknown can we permit ourselves without unleashing uncontrollable menaces? What ignorance should we regard as relevant and how much can we ignore as inoffensive? What balance between control and chance is tolerable from the point of view of responsibility? Is the unknown a wildcard for taking action or just the opposite, a warning that maximum precautions must be taken?

These are the deep reasons why a knowledge democracy is not governed by expert systems but through the integration of those expert systems into broader procedures of government that necessarily include decision-making in areas where ignorance is irreducible. Our principal democratic controversies revolve precisely around the amount of ignorance we can permit ourselves, how we can reduce it with forecasting systems, and what risks it is opportune to assume. The challenge facing us is

that of learning to manage these uncertainties, which can never be eliminated completely, and transform them into calculable risks and learning opportunities.

Contemporary societies must develop not only competence in solving problems but also the capacity to react suitably to the unexpected.

While the first Enlightenment aspired towards clarity and exactitude, the second has to make do with unfathomability, inexactitude and uncertainty. The first Enlightenment assumed there was nothing problematical in the aggregation of rational components, whereas the situation now is that the convergence of parts (of individual interests and the interdependence of systems) gives rise all too often to an irrational totality: knowledges do not accumulate but generate confusion, interests are not aggregated but neutralize one another, the increase of information enhances not the transparency but the opacity of the whole, and decisions, even if individually rational, trigger fatal consequences. What theory and praxis of government respond to this new constellation? The government of intelligent systems might well be an appropriate denomination for this new challenge.

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Energy Governance and Sustainability as a Vector of Change

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In its periodic reports on the situation of our natural resources (water, soil, energy, biodiversity, etc.), the United Nations has been arguing for some years that “the crisis is not one of resources but of the management of resources.” In other words, the richest or best countries, those with the highest levels of well-being and the greatest chances of achieving sustainability are not the countries with the largest amount of resources but those which best manage the resources they have, as is clearly shown by countries that exemplify the two extremes of this thesis, such as Venezuela and Denmark.

The crisis is not one of sustainability but of governance, governability or simply good government. There is no sustainability without governance, and this is particularly evident where energy resources are concerned, with climate change as the result of their mismanagement on a national and global level. There are enough resources, and ones that are moreover renewable, to satisfy global energy requirements in a sustainable way now and in the future, but what is needed is a radical change in our energy policies.

Such a change clashes head-on with the interests of many countries with fossil resources, and of energy and electric companies whose source of income lies in the economy of coal and fossil fuels (not forgetting nuclear energy). These interests, generally speculative and short-term in outlook, are strengthened by cartels such as OPEC or simply by oligopolies, as in the Spanish case. Interests of this kind make for positions of extreme resistance, as that of the United States was until recently, a resistance tempered only thanks to the mandate of Barack Obama.

The Challenge

The challenge is not a technical one, as we have mature and accessible technology for renewables, nor is it economic, since most technologies have surpassed not only what is known as “grid parity,” by equaling costs at the point of supply, but also “generation parity.” This is shown by the fact that in 2015 investments in renewables for generation of electricity have been much greater, and with much more installed power, than in fossil and nuclear technologies. This is the situation even despite the fact that not only do the latter not internalize their environmental costs but also, appearances to the contrary, they received nearly four times as much aid and subsidies in general as renewables, according to the International Energy

Agency (IEA) itself. The challenge is simply political, it is one of “good government” or governance.

What is all this about governance? And what chances do we have of using it to propitiate energy sustainability, thereby responding to an otherwise necessary and opportune change in the energy system (and with it the model of production and consumption in general), which would result in a true mitigation of climate change?

Acting Is the Key

The key is to move from reactive to proactive positions. Although it has not been sufficiently explained or, above all, emphasized, that is what is provided for (thanks to the negotiating capacity and diplomacy of the French team headed by Laurent Fabius and Ségolène Royal) by the Paris Agreement, now coming into force. Indeed, the preparations for the Marrakech Summit (COP 22) in November 2016 confirm that the goal of establishing the rules for the implementation of the Paris Agreement implicitly calls for a reliance on renewable energies in making the transition toward more sustainable energy and progress.

It is crucial that we have gone from talking simply of the intention of reducing greenhouse gas (GHG) emissions to considering them an objective, as a result of a promising and opportune change in the energy model and system at every level. Even if there were no climate change, this transformation would in any case be necessary. Climate change, however, obliges us to act more quickly.

Above all, climate change has equipped us with something fundamental for the “governance” of this change in the energy model. In the measurement of GHG emissions and their corollary, the increase in global temperature, it has provided us with an indicator to establish the inexorable route from here to 2050–2100, which is in no case to exceed a 2°C increase in global temperature and if possible to keep the rise below 1.5°C.

Let us hope that this will lead to a definition on the route map drawn up in subsequent summits, beginning with Marrakech, of the intermediate goals to be attained regarding GHG emissions. Said intermediate goals will result from the sum of the commitments accepted by the signatory states of the Paris Agreement, and could include:

- Reaching the peak of the greenhouse effect before 2020, in line with the IEA’s “bridge scenario” proposal for CO₂ emissions. Considering the

reduction in such emissions in 2014 and 2015, this might already have been achieved thanks to the decrease in coal burning in China and the USA, and should therefore be maintained.

- A 60 percent reduction of GHG emissions by 2050 with respect to 1990, as the European Commission proposed before Paris (surprisingly defended by the Commissioner Arias Cañete), in order to reach a practically “decarbonized” energy and economy by 2100.

This proactive approach is legitimized simply by the consideration that this reduction in GHG emissions, or decarbonization of energy and the economy, will not only do away once and for all with the atmospheric pollution of our cities (“Spanish cities are being asphyxiated,” we read in the press) and its huge impact on our health—something that is not sufficiently stressed—but will also involve:

- A “de-energization” or reduction in energy demand through more effective and efficient consumption, healthy also in economic terms.
- The “dematerialization” of the economy in order to reduce inputs not only of energy but also of non-renewable resources, raw material and so on, which in turn is mirrored by an equivalent reduction in the generation of waste (there is symmetry between “zero emissions” and “zero waste”), a step that is also necessary for environmental and economic reasons.
- The substitution of non-renewable energy sources and their related technologies, which are environmentally and socioeconomically unsustainable, with renewable energy sources and technologies, the best alternative from every point of view, and inexorably a part of the future.

The Role of Renewables

Renewables provide a key strategic element for the sustainability and progress of countries and regions. Energy sovereignty, achieved with autochthonous and renewable resources, is instrumented, I prefer the term, by “connected energy self-sufficiency.”

Unfortunately for the energy and electric companies, such self-sufficiency is already possible where electricity is concerned. There is a growing number of electrified systems at domestic level in self-consumption dwellings and buildings, and the same is true of whole

The fossil fuel age is not coming to an end because fossil fuels are running out, or even because they cause climate change (as they do), but because there is moreover a much better alternative: renewables

neighborhoods, farms, industrial compounds, and municipalities with distributed generation and integrated energy management, which could even lead to the municipalization of the energy grid, as occurs in Germany.

As a Nobel Prize laureate has pointed out, “the Stone Age did not end because there were no stones left, but because there were better alternatives: metals. The same is true of fossil fuels.” The fossil fuel age is not coming to an end because fossil fuels are running out, or even because they cause climate change (as they do), but because there is moreover a much better alternative: renewables.

The first industrial revolution was based on coal, and the second on petroleum. The third is already being based on the abandonment of both as fuels and a decisive switch to renewables. As in those cases, this shift towards energy sustainability could be the vector of change¹ (or in any case a decisive vector) toward more sustainable progress, more effective and more efficient in the use of resources in general (Fundación Renovables 2015).

The important thing is that this change in the model of production and consumption, which, like any paradigm shift, would otherwise have taken decades or even generations to take place, is now linked to a time schedule. The years 2050 and 2100 are the unpostponable deadlines for mitigating climate change and adopting a clear alternative: renewables.

We know what is happening and will keep happening if we continue using fossil fuels. We even know what has to be done to escape this growing cycle of unsustainability and enter the path of sustainability, not only of energy but of the economy in general. If energy changes, everything changes.

Organization for Governance

If all this is so obvious, then why is this necessary and opportune change not already effectively under way? Why is it that since 1992, when the Convention on Climate Change was agreed at the Rio Summit, emissions have continued to rise, and with them the levels of GHGs in the atmosphere, the average global temperature, and in consequence, the impact on the world’s climate in general? Why have we had to wait until December 2015 to achieve an agreement subscribed by most countries that is still, as the United Nations points out, clearly insufficient for the achievement of the goals deemed essential for 2050 and 2100?

The answer is quite simple: because we have been incapable of organizing ourselves properly to manage the change. This is because these inexorable scenarios of sustainable energy and socioeconomic sustainability are not yet accompanied by the mechanisms of governance necessary at a global level to manage route maps for overcoming the short-term interests of the various countries and economic sectors linked primarily to the fossil fuel economy.

The challenge for the Marrakech Summit and subsequent climate summits up to 2020, when the cutbacks in emissions undertaken by the different countries in the Paris Agreement will start to be applied, will be to establish not only the regulations for homologating each country's efforts to reduce emissions (reference dates, sectors involved, etc.) but above all to agree how to make these commitments much more ambitious. According to the United Nations, we need a general reduction of up to 25 percent more by 2030 if the agreed global objective, a temperature rise of no more than 2°C and preferably less than 1.5°C, is to be respected.

The challenge lies in the governance of the Paris Agreement, as can be surmised from the fact that what major countries such as the United States and China were resisting was not so much, or not only, committing to the reductions but rather abiding by rigorous monitoring mechanisms for such commitments, with checks (always under voluntary schemes, since the possibility of binding commitments such as the ones that apply to EU states was out of the question) taking place every five years.

Finance

Among the difficulties of governance we must include what is always the thorniest issue: the predictable provision of funds for financing the agreements. The most important such agreement is the one reached in Copenhagen in 2009, which is supposed to raise 100,000 million dollars by 2020. This figure constitutes the condition for the countries most affected and least responsible for climate change—generally developing countries—to join the agreement as receivers of economic resources to adapt and contribute to climate change mitigation. Some of the receiving countries, such as Cape Verde, Samoa and Papua New Guinea, are spearheading the proactive position outlined above by committing to self-sufficiency with 100 percent

renewable electric systems and consequently “zero emissions” by 2030. This is a shining example for countries such as Spain, with more reasons and potential to adopt such an approach.

The challenge is not a trifling one. It requires radical changes in global governance if adequate management is to be provided for the objectives of emission reduction and the changes in energy and general economic models necessary for sustainability to be achieved.

In December 2004, at the end of his term as Secretary General of the United Nations, Kofi Annan seconded the conclusions of a report by a team led by Jeffrey D. Sachs. This defined the keys to global governability with the aim of progressing towards the Millennium Development Goals and global sustainability.

The first key was to have global strategies which now, in the case that concerns us, have clear substance in the so-called Global Sustainability Goals, and in particular in the climate change strategies established within the development mechanisms of the 1992 Convention on Climate Change and the 2006 Kyoto Protocol, now strengthened by the Paris Agreement of 2015. This is not the main shortcoming where strategies are concerned.

The second key was to develop global capabilities, necessarily within the United Nations, and embodied in this case in the United Nations Secretariat for Climate Change, the different working groups and commissions set up to implement the Paris Agreement, and other similar organizations within the United Nations Environment Programme (UNEP) or the Global Sustainability Goals, among others. In this respect, however, there are shortcomings. These bodies have very limited powers, since none of the goals are binding, nor can they impose economic sanctions for deviations from the relevant commitments acquired (as the World Trade Organization can). Most importantly, however, (and this shortcoming is connected to the third condition), they do not have the resources or a sufficient foreseeable budget to economically incentivize compliance and finance existing commitments, above all in developing countries.

The third condition was the need for shared global responsibilities that would acquire substance, as occurs at state level, in the existence of predictably available resources. These resources would be obtained by consolidating annual budgets with taxes or tariffs (can we imagine states financed with the voluntary contributions of their citizens, as occurs with the United Nations?), which in this case would be global. These

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responsibilities would contribute to global cohesion and cooperation, and to the proper distribution of charges and redistribution of the resources generated. They would also be the guarantors of a global budget, an instrument that would strengthen global capabilities and provide them with resources to incentivize compliance with the goals, and to finance programs for adaptation and mitigation in less developed countries. This is perhaps the most serious shortcoming for global governance, and for our ability to embark on proactive and operative processes to mitigate climate change, understood simply as management of a worldwide energy transition, necessary in any case, that will result in climate change mitigation and act as a vector of change toward global sustainability.

A Tax

Once again, climate change, thanks to the existence of an indicator as evident, measurable and controllable as emissions expressed in CO₂, has provided us with a powerful potential instrument, a global tax on CO₂ (preferable to the so-called “carbon pricing”) in order to finance the Paris Agreement. Such a tax was in fact already suggested at the Rio Summit in 1992, and was unfairly whisked off the agenda during the negotiations for the Kyoto Protocol at the insistence of the United States (which in the end failed to ratify the protocol) to provide for another not-so-efficient economic instrument, tradable emissions permits, in what proved to be a lost opportunity.

A tax equivalent to 3–4 dollars per ton of CO₂ would be sufficient (its repercussion would be just over one cent per liter of fuel, or one third of one cent per kWh produced with fossil fuels, for example) to secure the 100,000 million dollars per annum that have been committed, but not so far advanced, to implement the Paris Agreement.

Owing to its fiscal repercussion, this fund could no doubt be multiplied four or five times simply to catch up with the subsidies received today by fossil fuels according to the IAE, or to double the investments in the generation of electricity with renewables in 2015, a year in which, as stated above, they surpassed investments in generation with fossil fuels.

This would satisfy the second and third conditions for global governance in climate change (capabilities and global economic resources) and sustainable energy. Additionally, it would almost certainly make the goal of

zero emissions a desirable and advantageous reality, together with that of efficient (up to 50 percent less final energy consumption) and 100 percent renewable energy systems by 2100. The process would be punctuated by a reduction in emissions by 2030 that would be 25 percent greater than the number stipulated in the Paris Agreement, and a reduction of 60 percent by 2050 of the emissions recorded in 1990.

All this might put us on the path to remaining below a 1.5°C global increase in temperature, besides achieving more sustainable energy systems and progress in general. Not forgetting an added dividend, the drastic reduction in atmospheric pollution in our cities.

So why wait to demand global fiscality on CO₂ (we might start with kerosene for aviation, which currently pays no taxes) in order to ensure governance of the Paris Agreement? This fiscality would ensure we have the funds necessary to achieve sustainability with our energy system and the resulting mitigation of climate change. It would also finally introduce the vector of the necessary change in the model of production and consumption, as we advocate at the Fundación Renovables.

Let us imagine for a moment what it would mean to add a proactive approach to climate change as the climax for change already propitiated by the Paris Agreement, and due to be reinforced in Marrakech, in the form of a global CO₂ tax that would supply predictable resources proportionate to the effort to be made, and which would gradually disappear with the “decarbonization” of the economy. It would put the Paris Agreement in “turbodrive,” but this time with renewables.

Notes

1. Fundación Renovables. 2015. *La energía como vector de cambio para una nueva sociedad y una nueva economía* [Energy as change vector for a new society and a new economy]. Madrid: Fundación Renovables.

Technology and the Democratic Management of Urban Complexity

Michael Batty

The computerization of society has now reached the stage where hardware and software are rapidly spreading out into the built environment and enabling ourselves as both users and designers of cities to automate many of our routine practices and functions. This automation has given rise to the notion of the “smart city:” cities in which digital media is heavily embedded in public and private places, enabling us to function better, to become smarter citizens, by producing much more secure, sustainable and livable environments. Once we build information infrastructure into cities—which is no more, or less, than what we have been doing for the past two hundred years with conventional transportation infrastructure—we are not only able to control the functions of the city in better ways but we are also able to enhance our understanding of cities and their planning thanks to the useful information generated by such infrastructure. Much of this data is streamed in real time and in this sense it is “big” in terms of its volume. Therefore, we need to employ new digital methods to explore and manage it. Such big data is essentially the “exhaust” or by-product of the smart city, and we are only just getting to grips with assessing how useful this is likely to be for managing the future city.

Cities, of course, tend to be sustainable under many varieties of technological disruption, such as the introduction of new forms of automation and changed behaviors associated with them, for they are highly adaptive, complex systems. But the real question is whether cities are becoming more sustainable in terms of their living environments with the kind of technological change that currently dominates their development. We are living in a time when our ability to communicate with one another is being dramatically enhanced by new information technologies (IT). The issue we need to consider is whether or not the gains in efficiency derived from these developments are leading to more livable and equitable urban environments. To this end, this chapter will explore the ways in which these developments are being implemented under the guise of the smart-city movement. Smart cities imply smarter responses to urban problems but at the same time these responses, like many developments in cities, can be divisive and confusing, and might go against the more general goals of sustainable urban development.

Currently the smart-city movement embraces a perspective that examines the city through its most routine functions. These tend to include the flow of information, materials, and people which takes place daily and which we record over a relatively brief period of time, be it minutes, hours or days. In fact, city planning in the past has been largely about how cities change and are

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planned on much larger time scales, over years and even decades, which reflect the time required for substantial spatial change to take place. But the fact that we now have the ability to capture data in real time using a variety of sensors is changing the way we look at cities, shifting the nature of our planning and design to the much shorter term. Data is being captured either through passive sensors embedded in the built environment or active ones which we control through our own actions, typically smartphones and portable computers of various kinds. Much of this data capture is made possible by the electronic skin that has been layered across the planet in the last thirty or forty years, with the Internet and its visual interface constituting one of the most dominant modes of communication. Many private networks at many spatial scales also exist and interact with the Internet in diverse ways—a fascinating glimpse into this world is contained in Andrew Blum’s book *Tubes: A Journey to the Center of the Internet* (Ecco Books, 2013). But most of the time this world is hidden to us and we only see evidence of the smart city in the most superficial way—in the use of our own devices as smart sensors, in the data that is provided by them and packaged into information delivered to us to help our decision-making, particularly in terms of travel, retail purchasing, perhaps in how we might control energy use at home in basic ways involving heating, and in the delivery of online financial services, increasingly known as “fintech.”

As a matter of fact, our image of the smart city is much more comprehensive than the reality of it. The big computer companies, such as IBM and CISCO among many others, portray an image of the smart city where everything is integrated in seamless fashion, where there is universal access for all, and where the prospect is one of continued sustainability. The reality, however, is very different. New information technologies do require integration—which ranges from interoperability over different platforms to different data being linked to each other—but this is extremely difficult to achieve, not least because software and indeed hardware is increasingly developed ad hoc.

It could not be otherwise, for developments in computation involve new discoveries and it is impossible to invent and develop a piece of hardware or software able to anticipate all future developments, no matter how flexible and open its design. Sustainability can thus be compromised by the fact that we can never know the future. In fact, all complex systems are like that—they evolve in an organic manner rather than being designed from the top down as rigid and fully functioning structures.

The other message that has been preached in the last thirty years in terms of cities is the idea that they are complex systems, more like organisms than machines, systems that grow from the bottom up, never designed in their entirety, and that, for the most part, undergo incremental development. Such development is not irrational: it may be very rational in function but the design of complete cities is a rarity, often conceived as an ideal type and predicated as a demonstration project. A number of smart cities have been designed this way, almost like company towns: the digital new towns of Masdar in the United Arab Emirates and Songdo in South Korea are examples of what might be produced in idealized, optimal conditions. But like conventional new towns before, they tend to force population behaviors into something of a straightjacket.

Smart cities, which as mentioned above are part of the current stage of the computerization of society, trace back their origin to the Industrial Revolution and the use of mechanical technologies in the late eighteenth century. Cities were then transformed by electricity in the late nineteenth and early twentieth centuries, and have been powered by digital computation since the mid twentieth century. This automation has permeated virtually every corner of our lives. Thus the smart city, which is the most recent stage of urban development, can be defined in multiple ways through multiple applications of digital media and IT. It is not possible here to define all of these, for they are everywhere, but some are more important and widespread than others, and in this brief outline we will focus on three of them: the first dealing with transport, the second with social media and social networks, and the third with citizen services and citizen science. Each of these examples has different implications for increasing the sustainability of our cities, and in each case there is evidence that these developments will both enhance and detract from the general goals of increased sustainability.

For over 50 years we have been collecting data on the supply (numbers, type, etc.) of vehicles through loop counters embedded in roads, though progress has been slow in terms of collating ticketing data into transit demand measures. Some of the first IT developments in transport involved automated ticketing, and in many large cities—cities with a population in excess of two to three million people and underground transport networks—such systems are now routine. In London, whose inner core is home to over eight million people, some 40 percent of the population travel by public transport, 85 percent of which use the standardized automated ticketing associated to the Oyster card. This is the smart card which records the details of every tap in and out of the system,

It is impossible to invent and develop a piece of hardware or software able to anticipate all future developments. Sustainability can thus be compromised by the fact that we can never know the future

the cost of each trip, and the stored credit available for travel which users load onto their card. There are approximately twelve to thirteen million such taps per day on tube, overground rail, and bus, and the data obtained in real time—according to location at the start and end of each trip, and time elapsed in seconds—provides a unique record of the behaviors of the travelers and the dynamics of the transit system.

This data can also be used to control such systems. It is possible to extract the functions of travel from where people enter and leave the system by comparing this with land uses and activities at different locations, and to explore the enormous heterogeneity of travel which is associated with these functions. The impact of disruptions on the system can be studied with respect to the cascading effects of stalled trains and signal failures on the paths and trips made by travelers and then used to suggest strategies of mitigation.

These are all features at the cutting edge of what the smart city might deliver in terms of transit, so that the quality of the travel experience can be improved and made more sustainable; but the clearest benefits to date involve the delivery of information online through apps on smartphones or digitally within stations, where displays and dashboards inform travelers about the state of the system. There are now at least two dozen systems around the world with comprehensive automation and an increasing number of smaller systems with part automation, and it is very likely that most transit systems in the wealthier G20 countries will be automated in this way by 2025. In fact, purpose-made smart cards are likely to disappear as such automation is ported to contactless payment cards (credit, debit and the like, as in London now)—a development that mirrors the massive proliferation of purchases now made electronically either directly in stores or on the web, which is part of the growing electronic skin of the planet we noted above. Add to this mix the commercialization of autonomous vehicles, which are self-driving and self-maintaining to different degrees, and the prospect of widespread automation in travel will soon lay before us, making this aspect of the smart city a reality. These are important elements of increasing sustainability with respect to congestion, accessibility and mobility in cities.

One of the most pervasive and fastest growing features of the smart city involves social media. Since the use of smartphones became widespread, as the cost of telecoms and phones fell and messaging apps became available, there has been enormous growth in individual access and messaging to websites that enable people to

communicate virtually anything they care to think about. Some half a billion tweets (short text messages) are posted to Twitter each day; the number of registered users in Foursquare, a similar but more niche social media site, is much smaller at 60 million; but both of these pale in comparison with the over 1.7 billion users of Facebook; and the list goes on: photo sharing sites such as Flickr now have 112 million users, while Instagram has more than 500 million. In China, similar but separate systems are fast emerging; these include Weibo, a social messaging site like Twitter, and Baidu, the search engine equivalent to Google. When we consider web search and email traffic, the size of the digital world positively explodes, and many of these statistics now correspond to significant fractions of the world population. Much of this is taking place in cities, possibly and hopefully making us all better informed and smarter while at the same time raising problems about personal privacy, confidentiality, ownership of intellectual property, and so on. The extent to which all these new media which have come upon us in the last decade are changing our behavior poses an enormous challenge to the way we understand the world, particularly the world of cities, the role of location, and the impact of globalization.

To some extent there is skepticism as to whether or not these new media are actually changing the traditional functions of the city. They may simply be reinforcing traditional modes of behavior, but as the data streamed by the sensors built into the various devices and applications is so unstructured, it is extremely difficult to search for patterns that might be different from those that we are aware of traditionally.

The other domain of data which is genuinely a product of the smart city is the much more interactive basis of Internet use known as crowdsourcing—where “crowds” or individuals forming a population create their own data from their own responses, which are recorded through the medium of the web. Despite the notion that the power of the crowd might come to a somewhat different or more intelligent conclusion than unstructured responses of many individuals, crowdsourcing data collection is now possible if enough people have access to a web-based media and are motivated to respond to a particular set of questions, issues, or challenges. This general area involves not only the creation of data but furthermore concerns data used for purposes which often work towards the empowerment of those involved in collecting it. Citizen science is the term often used to suggest that this activity is one in which citizens themselves can become smart, in that they are part of the process of collecting data that might make the city smart.

A rather basic and perhaps mundane but immensely successful effort is the crowdsourced mapping technology Open Street Map – OSM (www.openstreetmap.org) which involves relatively informed but amateur attempts to generate as detailed a map of an area as is possible at the level of streets and land parcels, including the activities or land uses that pertain to these. OSM is producing maps that are as good, if not better, than those produced professionally by national mapping agencies, with the added proviso that these maps get better and better as informed volunteers correct errors and add to their content. It is also part of the wider movement to make data “open,” with crowdsourced data of this kind being open to others almost by definition. This is giving added impetus to government and other sectors to open and share their data more freely than has been the case in the past. In this sense, smart cities are cities where open data is the *modus operandi* of making citizens smart and giving them power over their future with this new technology. This, we believe, enhances their sustainability.

All of these technologies and the efforts to implement them have the potential to make the city smart. It is worth noting that the term smart is peculiarly American in its usage, but the downside is that it has become such a buzzword that it is being applied to every aspect of the city at the present time. Perhaps this is no bad thing because it does draw attention to the difficulties of widespread automation, the disruptions that are taking place, and the notion that traditional ideas about place-based activities need to be extended to movement and communications. New information technologies are providing an entirely different basis for communicating with one another than was possible in the past, and this is changing the nature of place. The terminology of the smart city will not last, as there will come a point in time when the focus of new IT will move from this public domain to other cutting edges—probably medicine, possibly the alleviation of poverty, perhaps the restructuring of government. And it may take some time before the promise of integrated IT systems—platforms, as they are increasingly being called—become a reality. But what is clear is that the industrial revolutions, of which the smart city is but the latest, are changing the concept of the city from a place-based set of activities to a set of activities that exist in a different kind of reality where information will be the new energy, the new fuel that will power the way we work and function in cities. In fact, when we move beyond the smart city, we may no longer talk of cities in a world where we are all in constant communication with one another, no matter where we are. In this sense, we consider that what is now happening with new technologies does herald an era when cities are likely to become ever more sustainable.

Ice

Nick Cobbing

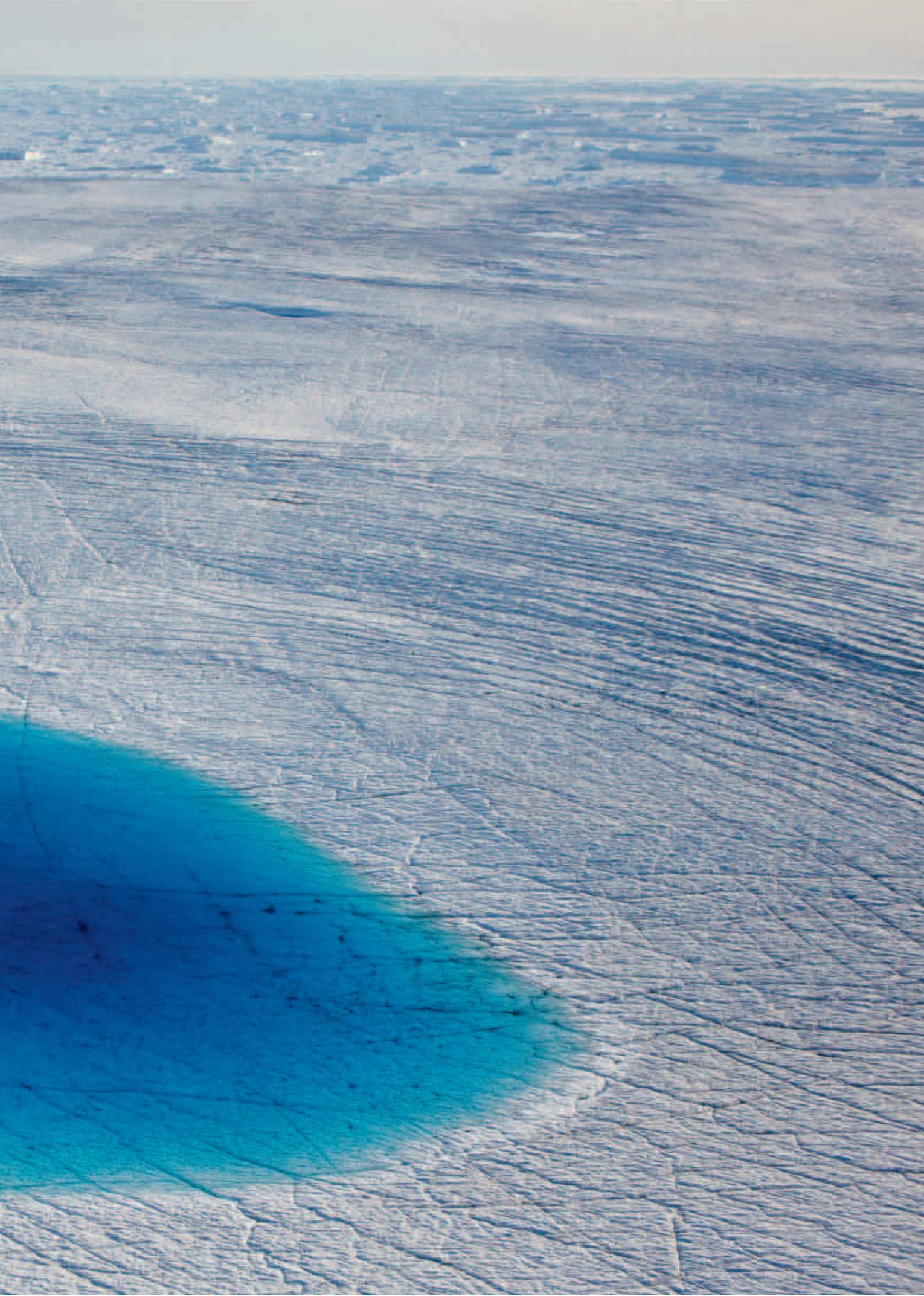
The photographs of Nick Cobbing (United Kingdom, 1967), taken over several decades, testify to the changing character of natural life in the Arctic regions and the urgent need to care for it. Having embarked on many expeditions with international organizations such as Greenpeace, his camera has managed to capture the beauty and fragility of the frozen landscape. His photographs are the most eloquent image of climate change, and have done much to raise awareness of it.





The Arctic Sunrise at the edge of the Arctic Ocean sea ice cover, Greenland, June 2009





A melted lake high up on a glacier on Greenland's west coast, July 2009





Norwegian research ship, Arctic Ocean (north of Svalbard), February 2015





Arctic Ocean between Greenland and Svalbard, October 2007





The Arctic Sunrise at the edge of the Arctic Ocean sea ice cover, Greenland, June 2009





Narsaq, Greenland, August 2005

If journalists do not cover climate change then they are missing the greatest threat to humanity ever. And if journalists do not tell the story of how to avoid the worst-case scenarios then they are leaving their readers without any hope for the future

Suzanne Goldenberg

8. *Communication for Change*

Landscape allows us to recognize a new scenario of our heritage. It has been established that administrative bodies will look after the historic, artistic and natural heritage, but the landscape heritage, which is a country's geographical heritage and is therefore exposed to every inclemency, has not yet been included

**Eduardo Martínez
de Pisón**

Ours is the first generation to have understood the gravity of problems like climate change, and it is probably the last that will be able to act with effective solutions

María Novo

The Responsibilities of the Media

Suzanne Goldenberg

Many years ago, when I was at the beginning of my career in journalism, I worked in a newsroom with a man who had a strange habit of jumping out of his seat for no apparent reason and raising his arms in the air, loudly declaring to no one in particular: “I fear the worst.” My colleague, who was otherwise a quiet, mild-mannered man in middle age, would immediately sit back down, hunch over his keyboard and resume typing as if nothing had happened. If you looked his way after one of these eruptions, he might offer a small, benign smile but there was never any explanation forthcoming for his agitation.

This was certainly unusual behavior, even by the newsroom standards of the day, when eccentricities were generally overlooked or even welcomed as a way of relieving the tedium of the night shift. Over time, with our colleague still disinclined to offer any explanation for the recurring eruptions and no one daring to ask outright, a few people began putting forward their own interpretation of the bizarre behavior. Some claimed to have noticed that particularly strenuous outbursts from our colleague would be followed by breaking news of an earthquake, a tsunami or some other natural disaster, a refugee crisis, a famine or a war. That is, bad things happened, just like our agitated colleague had said they would. And so we began to joke among ourselves that he possessed the powers of prediction.

Just as often, of course, the worst did not occur. Our colleague would leap out of his seat, agitated as ever for no particular reason, and it would remain a routine news day for the duration of our shift. We were less inclined to notice those occasions, however, precisely because nothing dramatic had happened. There had been no reason to notice anything, it had been a routine shift.

And that is the importance—and also the challenge—of reporting about climate change and sustainability.

Climate change is a life-and-death threat on a planetary scale. It is the human rights story of the twenty-first century. Heat waves and floods, food shortages and climate-spurred migration are already upending the worlds of business and politics, threatening global security and decades of development.

But telling that story—relaying the enormity of an upheaval that has yet to fully unfold, that is occurring at a much slower pace than the 24/7 bombardment of the digital news cycle—is incredibly difficult. It is perhaps a story too big to tell. The story of climate-inflected events does not readily conform to a single, easily digestible message. It is messy: it is global but the effects are

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hyperlocal, and it does not have a clear beginning, middle, and end—at least not one that is understood fully by scientists at this time.

If journalists do not cover climate change—the rising seas and sudden downpours that are already causing regular “nuisance” floods in cities like Miami and Manila, the blistering heat waves from Abu Dhabi to Australia, and the rapid melting at both poles—then they are missing the greatest threat to humanity ever. They are not performing the public service that is a vital part of their job. They are not telling the public what to expect from climate change. They are not warning the public how to prepare for the worst—and in good time, so that they can take measures to avoid upheavals and unrest.

And if journalists do not tell the story of how to avoid such worst-case scenarios—the free fall in the price of solar panels, the advances in battery storage, the lengthening range of electric cars—then they are leaving their readers without any hope for the future.

The worst does not have to occur. With careful planning, it is possible to escape catastrophic scenarios—by moving to less polluting energy sources, by adopting better technologies, by careful use of existing resources. And those choices often bring their own benefits: the more sustainable course would have been the better choice, even without the forcing of climate change. That is a message that has been sounded for years by economists and government officials.

There have been mountains of studies about the savings that would result from careful preparations to avoid the worst effects of sea-level rise, extreme weather and other climate impacts. Accurate weather forecasts, early-warning systems, and shelters have demonstrated it is possible to avoid mass casualties that used to be commonplace with hurricanes, even in low-lying developing countries, such as Bangladesh, which are exposed to greatest risk. In Rotterdam and Hamburg, construction of flood gates and town planning—putting important infrastructure above the high-tide line, designating city parks as water catchment areas—protects billions in property from flood damage.

But the slow and orderly work of planning for disaster rarely jumps up and announces itself as a breaking news story. It’s a story of incremental change, damaging setbacks, and outcomes that fall short of the original soaring goals. It’s not the short, sharp shock of the big disaster story. It’s not the type of feel-good story that immediately goes viral.

It’s a difficult balance, further complicated, especially in the US, by a disinformation campaign by corporations and conservative billionaires that has—until recently—made it politically risky for the White House and Congress to confront climate change, and that has confused the public about the dangers of warming.

In November 2009, only weeks before governments were due to gather in Copenhagen for a major United Nations climate summit, unidentified hackers broke into the servers of the University of East Anglia’s Climactic Research Unit and published over a thousand of the climate scientists’ private emails online.

The timing could not have been worse. The election of Barack Obama, who had campaigned for the White House warning of a “planet in peril,” had put climate change back on the US political agenda. With the run-up to the Copenhagen summit, the threat of climate change and the need for global action finally commanded public attention. The hack caused an immediate uproar.

Leading conservative figures such as Sarah Palin, the former US vice-presidential candidate who notoriously denies the planet is warming, claimed the emails showed that climate scientists had colluded to hide data showing temperature rise had stalled. They based their arguments on a highly selective reading of the emails, but the breach conveniently fed into the climate change deniers’ narrative that the science of climate change was still not settled. Four separate investigations subsequently cleared the scientists of falsifying their data, but by then the Copenhagen climate conference had already ended in collapse.

The email hack did not cause the collapse of the Copenhagen summit. The global economy was mired in a painful recession and climate change, seen as a distant threat, was relegated to the bottom of the agenda. With the recession, media companies were also fighting for their survival in a digital age that was destroying their economic model. Companies reduced their staff—including environment reporters. But the scandal sapped the political will to come to an agreement, and distracted the public. It was hard to argue that climate change was the real story when there appeared to be doubts—even among scientists—that climate change itself was real.

In reality, of course, the science behind climate change was already well established by 2009. Researchers began suspecting that humans were capable of changing the climate through the burning of fossil fuels in the late nineteenth century. By the second half of the twentieth

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century, the risks of climate change were seen as sufficiently serious to merit the preparation of briefing papers for US presidents Lyndon Johnson and Richard Nixon. In 1988, the leading climate scientist, James Hansen, told the US Congress that climate change was already occurring in real time—it was no longer a threat or a risk. Climate change was already happening.

But it would take fifty years after those early White House briefings, and twenty-five years after that public warning to Congress, before a US president took decisive steps to respond to the threat of climate change.

In the US in particular, oil and coal companies—and more recently electricity providers and conservative billionaires—bankrolled disinformation campaigns that sought to confuse the public about the risks of climate change. These disinformation efforts were extremely sophisticated, with the industry distributing money to a variety of front groups—think tanks, “astro-turf” groups which mimicked grassroots activism, “experts” in the pay of fossil fuel companies.

Those efforts proved remarkably effective: long after scientists had reached a consensus about the causes of climate change, leading US, British, Canadian and Australian news organizations continued to give an airing to so-called experts whose mission was to spread doubt.

Those so-called experts raised doubts that industrialized countries could run their economies on clean energy—without shutting off the lights and idling business. They warned that electricity prices would skyrocket, hurting ordinary consumers. They argued that efforts to deal with climate change would ultimately fail, claiming there was no chance other countries would join the historic big emitter, the US, in cutting emissions—even after China and other countries had embarked on the construction of ambitious solar and wind power plants. They even raised doubts about the existence of climate change—although the underlying science had been broadly accepted for years.

Those false assertions—amplified by think tanks and campaign groups—found their way into the opinion sections of newspapers, and too often into the news columns, in the name of balance. The result was very damaging, when it came to coverage of climate change, because the disinformation campaign muddied the message. With so many competing messages, it grew even more difficult for news organizations to seize on a clear storyline about climate change, and it became harder for the public to grasp the urgency of dealing with it.

And crucially the narrative of doubt found its way into the political agenda. One year after the collapse of the Copenhagen climate summit, efforts to pass US climate legislation also failed. For the remainder of Obama's first term in the White House, climate change was regarded by the president and democrats in Congress as politically toxic. And for many news organizations, that turned climate change into a non-story.

* * *

On a blistering June day in 2013 Barack Obama announced a sweeping plan to fight climate change, anchored on regulations cutting greenhouse gas emissions from power plants. "The question now is whether we will have the courage to act before it is too late," Obama said in his speech at Georgetown University. "And how we answer will have a profound impact on the world we leave behind not just to you but to your children and your grandchildren. As a president, as a father and as an American, I am here to say we need to act."

Obama made it clear he was done with waiting for Congress to take up climate change, and was directing US government agencies to take charge. He also began hitting back at opponents who deny the existence of climate change, dismissing them as members of the Flat Earth Society. Over the next three years, the White House went on to roll out actions and announcements about climate change almost on a weekly basis—and continued to hit back hard at climate change deniers.

The high-visibility climate campaign—reinforced by Obama's trips to climate-affected locations such as Alaska and Hawaii—also put climate change on the news agenda. Climate coverage on its own might be a non-story according to traditional news judgment, but the president certainly was news, and news organizations covered him. Over the course of Obama's second term, there was a far greater coverage of climate issues in US news outlets than before, while big newspapers such as the *Los Angeles Times* pledged they would no longer give space to climate deniers.

It took far too long—and it's not going fast enough. But the US is finally on its way.

Landscape, Culture and Sustainability

**Eduardo Martínez
de Pisón**

Landscape is a result, a formal decantation on the surface of the Earth. Landscape is moreover an expression of territory. And it is also a cultural interpretation of the configuration acquired by geographical facts. So in the words of Philipp Otto Runge, the painter who managed to put all colors onto the face of a sphere, “everything converges on landscape.” By accumulating spatial elements and historic times, landscape can show the keys to territorial compatibility or disharmony in one fell swoop. Seen in this way, landscape offers proof of sustainability.

As we have said, landscape is a configured (and sometimes disfigured) place. Geography, meaning localization and territoriality, is therefore the first step to its revelation. It is a unity that integrates natural and social forces, physical and human components, and internal pieces or territorial units. The formal constructs resulting from an evolution of all these ingredients are presented as settled, and inter-assembled in a local, regional and universal chorology. The geography of landscape which makes sense of such a mosaic or map is, then, initially a morphogeography. But it does not end there. Since landscape is furthermore a cultural discovery of the territory and not merely its formal decantation, the revelation of its profound, cultured and aesthetic aspects means that the perception of place is supplemented by its comprehension, even its sentiment, and naturally by its representation, its scientific and artistic image. In using the term “landscape” rather than “territory,” I am therefore including the latter as materiality with the addition of that image received through the senses, of the study which assembles its areas and components in an integrated fashion, and of the given culture with which it has been qualified. The act of seeing a landscape is one of discovering a higher dimension in the territory. The geographical fact is there, and precedes the discovery, but without the discovery there is still no landscape. Landscape is thus the sum of an ecological, historical and geographical whole with another interpretive whole.

Morphology is therefore the basis of landscape. Its forms show the Earth’s faces, including both its physical face and the physiognomies formed out of the natural picture by lifestyles, techniques and economic functions, as well as cultural and moral styles, categories and levels. When a territory is interpreted culturally and comes to be recognized as a landscape rather than merely being viewed pragmatically, it is reorganized intellectually, aesthetically and ethically.

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A special dialogue with broader contents is then established with it. Historic advances in the concept of landscape, its artistic representations, its methods of study and its social significance are achievements in the history of civilization that encompass technicians, inhabitants, politicians, thinkers, artists and scientists—that is, they affect the entire cultural body. The reading of a landscape is, then, the reading of a process and a cultural system. From its very sources as a modern science, geography has assumed that the correct understanding of landscapes stems from the principle of terrestrial unity, and of the combination, correlation and successiveness of phenomena. It only remains to add that when speaking of landscapes, culture is one of those phenomena.

Cultural representations of landscapes can even teach us to see. They guide our perception. Their pressure is so great that educational levels are decisive for an understanding of landscapes, since prior images help to improve the perceiver's vision, although it can also happen that the traveler—as Hippolyte Taine wrote of his journey to the Pyrenees in the mid nineteenth century—rebels against this and makes a virtue out of a preference for his or her spontaneous, personal and direct vision, refusing to deform it with previously acquired information of a geographical, literary or pictorial nature. This is generally inadvisable since, as Henry David Thoreau argued, we shall see all the more, the better we are prepared for it. Even the senses themselves are combined and transposed in a perceptive whole as a resonance of the unity of the real, the armature and the weave of the landscape. Implicit in the term landscape, as part of its existence, is the concept of structure. Behind forms lie invisible structures that order (or disorder) appearances. The Enlightenment and Romantic notion of “nature pictures” already rested on the fact that such pictures were the face of that geographical structure. The structure takes a form, the form presents a face, and the face is what we perceive. The function that builds up much of that structure thus lies behind any territory, which today is nothing but a cross-section of its historical process. Understanding place, however, leads to the contents and meanings that appear within any landscape. Inverting the terms, landscape for the writers of the 1898 Generation was a gateway to the spirit.

When viewed within a geographical framework, Ortega y Gasset's “circumstance” refers to landscape. Landscape thus appears as a condition and reference for life. Ortega added that if I am myself and my circumstance, then if I

do not save it, I do not save myself. This places landscape beyond the environment or any mechanical relation of mere productivity or survival. Rather than the traditional idea of the “environment,” Ortega wrote as early as the beginning of the twentieth century, we should say “landscape.” In our observation of the world, seeing the environment as landscape would thus require the revelation of a higher degree in the conception of places. In the specific case of anthropic landscapes, it would seek the correspondence between man and nature, which would make it necessary to move from a naturalist causality to a humanist one. The landscape would thus be the environment converted into circumstance. Landscape finally acquires the value of a concept that frees history of geographical determinism. In doing so, however, it entails a sense of responsibility, a behavioral ethic, as every freedom does. If we are free, we are responsible for our places and our landscapes. When the human gaze discovers the world as landscape, it also sees its depth behind appearances.

Landscape allows us to recognize a new scenario of our heritage. It has been established that administrative bodies will look after the historic, artistic and natural heritage, but the landscape heritage, which is a country's geographical heritage and is therefore exposed to every inclemency, has not yet been included.

Landscapes form tesserae that change gradually (or suddenly) from one to another of their principal modes of representation on the map of the Earth: those which are predominantly natural (but not necessarily exclusively natural), those predominantly rural (with their basis in nature and their references in urban groupings), and those predominantly urban (with a physical foundation and a nodal relationship with the whole functional, natural and rural system). In addition, there are mixed spaces. For a landscape is any territory that is interpreted as such, from Antarctica to Madrid's Puerta del Sol or the vineyards of Castile, forming regional, continental and even marine spaces in more or less tangled groupings. Every landscape is a well defined average unit of understanding that participates in other larger spaces and is itself composed of smaller grouped localities. In this way, the landscape is organized on different scales where the tensions between homogeneity and diversity define its geography. This permits its cartography, and thereby its establishment, its typology, its analysis, its communication and its management. In other words, its utility.

In this way, we have on the one hand what we call the material components of the scenario, where relief enters

The sustainability of landscape does not therefore lie simply in its maintenance but in suitable protection for the direction of its evolutionary dynamics, just like every living being

into dialogue with climate, water, vegetation and also man to form the basic weave of any landscape. Man, the great overall active agent in terrestrial landscapes, has recomposed the planetary film of the morphosphere. We have positioned the center of geographical interest within what is proper to our own species, in our reconfigurations and artifacts, and we have also multiplied the understanding of landscape in both time and space. We tend to blur the traditional diversity of landscapes, even dispersing “non-landscapes” around the planet, similar to one another, strange to their surroundings, and distanced from the geographical sense of place. What was once the original geosphere, which still maintains its key physical features as a basic order of the world, has thus lost both its nature and its diversity. The primitive biosphere has changed in the long course of geological time, but has also done so in the short course of historical time. We human beings have modeled an ecosphere to our measure, one that is now being transformed in such a way that the original geosphere, while always subject to change, is now turning into a technosphere ruled by artificiality, homogeneity and acceleration. Landscapes arouse less and less interest.

Landscape in which human additions and recompositions participate is, in short, a physical and anthropic complex, with increasingly rare and vulnerable exceptions. The habitual patrimony that appears on the Earth's surface, with its different predominance, therefore consists of this complex. This patrimonial landscape is the sum and the dialogue of its varied constituents, and its understanding and treatment thus requires multifaceted professional expertise from those who try to establish its various components and the sense of convergence necessary for a comprehension of the way they interlock. Landscape heritage, then, begins with natural morphogeography and ends with human territorial action (on the rural and urban heritage, on the regional system of relations, on the monumental and functional system, on the so-called constructed landscape, and on experience, comprehension and representation). The intellectual management of such a resource requires a great deal of effort and high levels of competence, but in a technological panorama of progressively decreasing interest in landscapes, this can only be assured on a solid cultural bedrock which, as we well know, is not developed or implanted everywhere to a sufficient degree. A rigorous approach to landscape is even more complicated when the composition of the geographical scenario is followed by infinite explanations of

experiences, feelings, tastes, thoughts, representations and projects, which make it necessary to enter the invisible. However, Ortega y Gasset himself wrote that the forest is more the latent than the patent, more the profound than the superficial, more the invisible than the visible, and more the inside than the outside. The forest is suggested to one within it, not seen by them, since it always develops behind the immediately perceptible line of trees, and like everything in reality, its most profound aspects are those which are least apparent. The theory is that the forest exists when it is interpreted as such. Bruno Zevi added in his book *Saper veder l'architettura* that humans are not accustomed to understanding space, since a vision of it requires three dimensions. To achieve this, we must situate ourselves in the midst of it. In other words, we achieve it only when the landscape contains us.

The patrimonial significance of landscape is drawn from its values. Once these are established, it has to be borne in mind that landscape is dynamic and therefore changing. The sustainability of landscape does not therefore lie simply in its maintenance but in suitable protection for the direction of its evolutionary dynamics, just like every living being. Achieving this means protection not only for its visible face but for the structure that generates it, the dynamism that gives it vitality and the change it requires, with attention paid also to the background of ideas, perceptions and images that feed it culturally. The “whole” responds only as a totality, and man and nature are within it in their appropriate place as part of its life pulse. In our care of the landscape, or in our lack of it, the positive or negative sign of sustainability is thus established. The final decantation of landscape is a central position in the system of territorial change and preservation. It lies at the confluence of three flows and vertices: the conservation of nature; the protection of resources, traditional customs and cultural components; and the regulation of activities, processes of change and educational uses.

In 1838, the Romantic writer José Zorrilla published a poem on the Creation. The earth, the hill, the breeze, the bird, the beast and man all appear successively, joining together in the landscape, until Paradise is undone by a twisted conscience: “the cool valley’s splendor was faded / the world trembled on its axes of diamond.” That was the beginning of a well-known story that will end only when “the tremendous day / of universal harm is done.” Let us hope so much drama does not have such a desolate ending. We should begin by restoring our

paradises. We have the instruments for it. But the task will certainly be made easier and more acceptable if the idea of sustainable landscape becomes one of these instruments, entering the concept, regulation and practice of its management. It might be like planting an arrow in the center of the system.

The Role of Art and Education. Change in Times of Uncertainty

María Novo

The Anthropocene, an Epoch of High Uncertainty

There is widespread scientific consensus on the evidence that we have entered a new geological period, the Anthropocene. Its fundamental characteristic is the enormous influence human beings have on the global bio-geo-chemical processes of the planet. With our technological actions oriented by an economy that does not respect the limits of the ecosphere, we have broken the range of variability of many natural cycles in an accelerated movement that leads us to a future plagued with risks, one in which our viability as a species is already starting to be questioned.

Global change is a reality. The planet has changed and is changing, influenced by the rhythm and intensity of our actions. Problems such as the lack of biodiversity, improper use of water and energy resources, the disarticulation of the territory, and several others configure a high-uncertainty scenario, in which anthropogenic climate change, caused directly or indirectly by our ways of life, stands out as one of the most significant factors.

In this uncertain context of global warming, humanity faces ecologic problems the effects of which may be irreversible. As Mario Molina, winner of the Nobel Prize for Chemistry, said of climate change, we know the system can suffer abrupt changes, but we do not know where or when. However, our world leaders are more attentive to economic, financial and strategic questions, generally reversible issues, than to the points of no return with which certain ecologic risks confront us.

The larger picture of this environmental crisis is very complex. It has implications of political, ethical, ecologic, economic and social order, and it involves enormous risks, such as massive migrations caused by rising sea levels, the probability of changes in the Gulf Stream, and diseases moving from south to north with the northward shift of the heat boundary.

If we had to characterize this situation with a single word, it would be “uncertainty.” Not only is the future uncertain, but so too, increasingly, is the present. We live in the midst of experimental processes whose short- and medium-term effects we can barely glimpse. This brings an uncertainty that is further fueled by war, famine, terrorism and other threats which have arisen from our inability to engage in dialogue on fundamental aspects of community life that would generate social peace. What we do know, however, is that if certain thresholds of risk are crossed (and we are close to doing so in some cases),

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the changes will be not only quantitative but also qualitative, and there will be no going back for certain phenomena.

What to Do about This Scenario

Clearly, urgent changes to our energy policies need to be implemented, with short-term priority accorded decisively to renewable energies, evaluating the subject not only in economic terms (necessary though this is) but also from ecologic, social and strategic perspectives. It is not a question of making a purely monetary cost comparison between energy sources, since the balance must also include the damage (negative external effects) that the use of fossil fuels causes to people's health, the state of the seas and oceans, the food we eat, and the air we breathe.

Within decades we must make drastic reductions in our greenhouse gas emissions, redefine the organization of large cities, reorient and incentivize reforestation policies, and educate the population of rich countries and sectors to consume differently, with self-restraint and awareness of limits. These and many other measures, such as sustainable water policies and conservation of biological and cultural diversity, could effectively bring about the civilizing change toward sustainability that we so badly need today.

For this change to take place, we must move around certain basic axes of thought and action:

- Awareness of the biophysical limits of the planet and the social limitations on our desires.
- Incorporation of ethics into economic and political decisions on every scale, with special emphasis on ecological ethics.
- Changed priorities in public policy-making and global governance.
- Changes in the management of natural resources (energy, water, food) on a local, regional and global scale.
- Changes in the collective imagination of the West and of the wealthiest countries and sectors, differentiating the purely quantitative “standard of living” from “quality of life,” measured with qualitative indicators.

Transformations of such magnitude are impossible without the involvement of people from all walks of life, the scientific community and the world of art and

creation. Making the population aware of such issues, stimulating the need for change, and constructing alternatives in the hearts and minds of the world's inhabitants is the task of education. Said education, or training, must reach not only the population at large but also, and especially, the professionals who manage the different areas of economic, political and social life, including planners, managers and decision-makers. The global problem requires urgent measures, and we cannot wait for the coming generations to realize what is happening and take appropriate action. Ours is the first generation to have understood the gravity of problems like climate change, and it is probably the last that will be able to act with effective solutions.

The Paradigm Shift

At the beginning of the twentieth century, science underwent a paradigm shift that was truly revolutionary for the interpretation of reality: moving beyond the approaches of mechanistic, reductionist and determinist explanations to embrace a complex vision in which randomness and uncertainty have a place. The research carried out by Einstein, Bohr, Heisenberg and many other pioneering scientists opened the gates for a new scientific concept that includes the impossibility of an absolute separation between the observer and that which is being observed; a form of science that overcomes the old dualistic vision of modernity (person/nature, mind/body) and proposes instead a conception of the world akin to a great machine that obeys deterministic laws. Cartesian and Newtonian visions of reality and its laws were hence not refuted, but they were resituated in their areas of validity.

From a classical perspective, a law of nature would be associated with a deterministic description, reversible in time, which privileged order and stability, and linked knowledge to the possibility of certainty. New science recognizes the vital role of fluctuations and instability, considers position one of the constitutive variables of the complexity of the real world, and expresses itself not so much in terms of certainties as of probabilities. Time (the arrow of time) enters physics, and the irreversibility of thermodynamic phenomena moves to the heart of the scientific gaze. Consequently, as Ilya Prigogine affirms, the future is not assured. We are living the end of certainties.

Complexity thus makes its way into the scientific spirit, permeating both philosophy and art at the same time. The new postulate attends not only to the quantifiable

The potential of artistic contributions to conjure up an alternative possible world lies not only in its added creativity and imagination but also in its historically proven capacity to anticipate

aspects of life but also to those which challenge the idea of a predictable, manageable and risk-free world, and it questions the attempt to separate the realm of reason from that of feelings and emotions. At the same time, a process is set in motion whereby history is accepted into scientific discourse, bringing with it the incorporation of two key elements for a complex interpretation of the world: the subject (the observer) and the context.

This vision emphasizes the interactions which take place in the living world, an intricate network of relationships and nexuses that is comprehensible only in systemic or complex terms. Philosophers such as Nietzsche alert us to the danger of reducing knowledge to formulae or closed truths. Reality is a cascade of realities, he says, incorporating the idea of the subject as multifarious and of knowledge as a multiplicity of constructs.

Popper illustrated this paradigm shift by asserting that science had gone from clocks to clouds, from a mechanical and predictable world to one which, like clouds, had fuzzy boundaries and was subject to constant change. Indeed, clouds provide us with the image of an inapprehensible and contingent world that makes and unmakes itself before our theories can grapple with it. They symbolize a complex reality beyond simplification, always diffuse, fluctuating, and above all unfinished. New science accepts that its truths are open to conjecture, and therefore provisional. They are necessarily open to disproof in confrontation with other ideas and theories which might better explain phenomena at any given moment. Uncertainty has come to stay in our way of interpreting the world.

In short, science on the one hand and reality on the other lead us to the greatest contribution to knowledge made in the twentieth century, which, as Edgar Morin states, is precisely the knowledge of the limits of knowledge; the impossibility of eliminating certain uncertainties. At the same time, our impact on the ecosphere has confronted us in the twenty-first century with the limits of our planet—limits which we are surpassing, with predatory ecologic and social effects which have resulted in extremely serious and intractable eco-social problems. It is a process whose consequences are largely unforeseeable. New uncertainty, growing uncertainty...

Scientists, thinkers and artists provide us with the diagnosis: we need a civilizing change that will allow us, with the necessary adjustments, to maintain our ways of life on Earth. We are facing new problems never before experienced by the human race, such as induced climate change. We cannot meet these challenges with our old

answers, yet no evident solution is forthcoming even when we try out new approaches...

Questions and Answers

We need to understand that when a paradigm changes, it is not the answers that change but the questions. As humanity, we must moreover ask ourselves not only different questions, as certainly is the case, but also questions of a different kind, ones that go beyond the field of economics and politics to enter territories such as ethics, philosophy and ecology.

From this point of view, the most significant questions we should ask today would not revolve fundamentally around the efficiency of our systems, hugely important though this is. The key to our questions is to be found, in my opinion, in the pertinence of the life models we have generated, and above all of those we wish to adopt. It lies in devising a way of relating to nature which no longer sees it exclusively as a provider of resources, and in adopting new ways of consuming, planning our cities and attaching value to the rural world. Clearly, this pertinence encompasses the need to ascribe a leading role to women in many cultures and to promote the cultivation of values such as harmony, solidarity in consumption, and cohabitability. It is essential to remember that as well as *Homo faber*, we are also *Homo ludens*, beings who dream and play together, and need to look one another in the eye so as not to feel alone.

We are at a giant crossroads, and the choice we now make collectively will be decisive for our future on Earth. This situation confronts us with changes of a Copernican magnitude that demand not only technological solutions but also an extra set of values, creativity and imagination that will enable humanity to evince a future of sustainable living. In the words of Federico Mayor Zaragoza, our societies are suffering from a deficit of soul, one which we must necessarily heal by recovering the true value of time and hope, of interpersonal relations, dignified labor, and of suitable forms and spaces of cohabitation.

Change in Times of Uncertainty: The Role of Art

Science provides us with the tools to forecast the gravity of problems such as global warming, rising sea levels, droughts and floods, which will become increasingly frequent and unpredictable. Technology can help us find

possible ways to mitigate these problems, though such mitigation will always be partial and incomplete. Both technology and science, however, are insufficient when it comes to imagining and elucidating possible worlds—new relations, values, qualities and properties of the real that are hidden to a purely experimental researcher. As the poet Valéry once said, imagining is tantamount to unlearning that which we are led to believe by custom and conventional language.

The great challenge we face is using the fragile and brittle material at our disposal to give birth to new forms of collective life, making a reality of those possible worlds whose qualities we can currently only intuit. In this task, the role of art and artists is fundamental. We must abandon the purely instrumental vision of nature and living systems, no longer considering them merely as providers of resources but recognizing the potentiality that lies hidden in them on an invisible plane. We need to discover our surroundings anew in astonishment, learn to look with new eyes, listen as though it were the first time, and perceive with all the senses available to us. Only this intuition of the invisible allows us to understand the true value of Life for our own lives, which consist of much more than producing and consuming.

Confronted with a scenario of increasing uncertainty, the profound change lying ahead of humanity if it is to advance toward a sustainable world presents us with the challenge of placing imagination and creativity, guided by ethical values, at the center of our thought and our decisions. Art can help us learn, imagine and express aspects of reality and complexities that are unintelligible from the scientific point of view. While science pursues precision (which is welcome but must always pay the price of its own limitation) art is able to expand our vision in the midst of uncertainty, since its goal is not to be precise but to pose questions and elicit brand new answers. Scientists and artists, meanwhile, need to be illuminated by ethics throughout the process.

We need a form of art that manifests itself as a privileged space for the creation of knowledge about the world we are being challenged to build, one vastly different from today's. In this respect, the potential of artistic contributions to conjure up an alternative possible world lies not only in its added creativity and imagination but also in its historically proven capacity to anticipate, which now more than ever is so necessary.

Uncertainty cannot be fought, nor should it be ignored. We must humbly limit ourselves to managing it as well as we can. But we are not ready to embark on such

The great educational challenge of this century is that people at any stage of education should learn to manage uncertainty

management. Addressing the great ecologic and social issues of our times we employ too many fixed rules and too little imagination. We repeat worn-out formulae and resort to the old instruments. Can we hope in that way for a civilizing change toward sustainability? For the moment, let us allow our artists to speak, give voice to people's dreams, listen to our profound but much neglected nature as humans, and also confront the challenge hand in hand with the philosophers, who remind us of a forgotten ethics, and the teachers, who are trying to save thought and wisdom from being smothered by information.

Uncertainty and Education, a Necessary Bond

When did uncertainty disappear from education? Or was it never really a part of it in the first place? Western culture has constructed potent educational systems which in times of lucidity, such as the days of the Institución Libre de Enseñanza in Spain, have incorporated all the creative potential of human beings into their pedagogy. It is no coincidence that those who came out of their classrooms include creators such as Salvador Dalí and Federico García Lorca, greatly admired today. Afterwards, however, rationalist methods came to the fore in the pedagogical field, fostered by an incipient technology that placed more emphasis on explaining how the world functions than on teaching how to think about possible worlds or question oneself on the ethics of good living. Lessons on the "how" eventually prevailed over questions about the "whats," the "whys" and the "who for."

Today this model has reached its culmination. From school to university, educational systems now emphasize information and the technological instruction of our children and youngsters. We teach them thousands of concepts, theories and computer skills, but we do not enthuse them with the pleasure of discovery, the kind to which the Nobel Prize winner Richard Feynman referred when he said that he had been attracted to the world of science by the infectious enjoyment of an adventure.

In making these remarks, I am of course speaking in general terms, and referring only to what educational systems today, at least in Spain, propose and expect of their students: that they learn a large amount of information and know how to handle themselves technologically. However, I should like to stress that I know there to be many educational centers and teachers that manage to dodge round these models and choose to

work with their students stimulating their creativity, their ethical values and their pleasure at allowing themselves to be surprised by knowledge. Are they representative of the majority? We shall leave the question open for each reader to reflect upon.

In my opinion, most of our education, from nursery school to university, with magnificent and highly estimable exceptions, provides our children and youngsters with answers to questions that they have not asked themselves. We go too fast for them, and this makes us unable to generate the conditions from which the questions could arise from them. We do not give them enough time or space to feel astonishment at the marvels of life. We keep them shut up too long in classrooms, where everything is under control, far from the real world with its uncertainties and problems. Randomness does not visit educational centers, and if it does, it is immediately reduced. Can we expect generations educated in this way to cope with the uncertain and insecure world we are leaving them? When will we start teaching them fewer theories and giving them decision-making tasks (which can be small but still educational) related to the conflicts of their environment?

On the same note, it is also worth reflecting on how many of the answers we teach them still respond to old questions, to a worn-out paradigm, and so have no meaning in our context, where everything, including necessarily our vision of the world and our strategies for engaging with it, has become more complex.

The great educational challenge of this century is, I believe, that people at any stage of education (for we adults also have to keep learning) should learn to manage uncertainty. We must be able to live amidst complex problems, make decisions even if we don't have all the facts at our fingertips, and imagine new scenarios for living that go beyond the real, testing their possible implementation. This challenge means something like introducing poetry amidst so much educational prose, restoring the value of questions and creativity, and accepting that true knowledge only settles and comes alive when it comes as a response to restlessness, interrogation and the sense of a quest.

The butterfly effect of the imagination could invade our educational spaces and turn them into places that conciliate reason and emotion, search and discovery, the visible and the invisible. Places with room for astonishment. We need education to enthuse the citizens of all ages with the pleasure of wandering down

unexplored paths that lead to sustainability and good living. And to achieve this, in addition to the mind and heart, we have to bring resistance and resilience into play, teaching how to construct out of adversities, to sing in the midst of the storm, to discover unexplored paths and overcome fears hand in hand...

In an uncertain world like the one we now live in and are condemned to live in henceforth, education must help us to confront questions of potential irreversibility as something urgent and vital. Our present and future are at stake. It is not a task to be left until tomorrow, since the problem is already burning in the dining rooms of our homes. Among other things, this predicament points to a need for joint, humble, collaborative learning in which all of us are called to share: the learning of cooperation, of the art of putting ourselves in the place of someone else's orphanhood, in order to recover the value of nature as a common home, the common ground among the human family, the quality of relations, knowledge as a shared construct, and life as an encounter.

Above all, we can and must imagine, imagine, imagine, guided by ethics and the art of good living. In the words of Ernesto Sábato, our youngsters need (and so do we) to learn to glimpse a horizon while standing before the abyss. For that is where we are in times of uncertainty.

Trees

Rodney Graham

The inverted trees of Rodney Graham (Canada, 1949) emphasize his interest in the behavior of visual optics and perception, in what is seen and what goes beyond that which is seen. However, they also demonstrate his concern for nature, whose most significant and poetic representation adopts the form of an ancient tree with its roots. His images, which are at once an artistic, technical and environmental reflection, thus become monuments to our natural surroundings.



Oak Tree, Red Bluff 1, 1993–2000





Oak Tree, Red Bluff 2, 1993–2000





Oak Tree, Red Bluff 3, 1993–2000

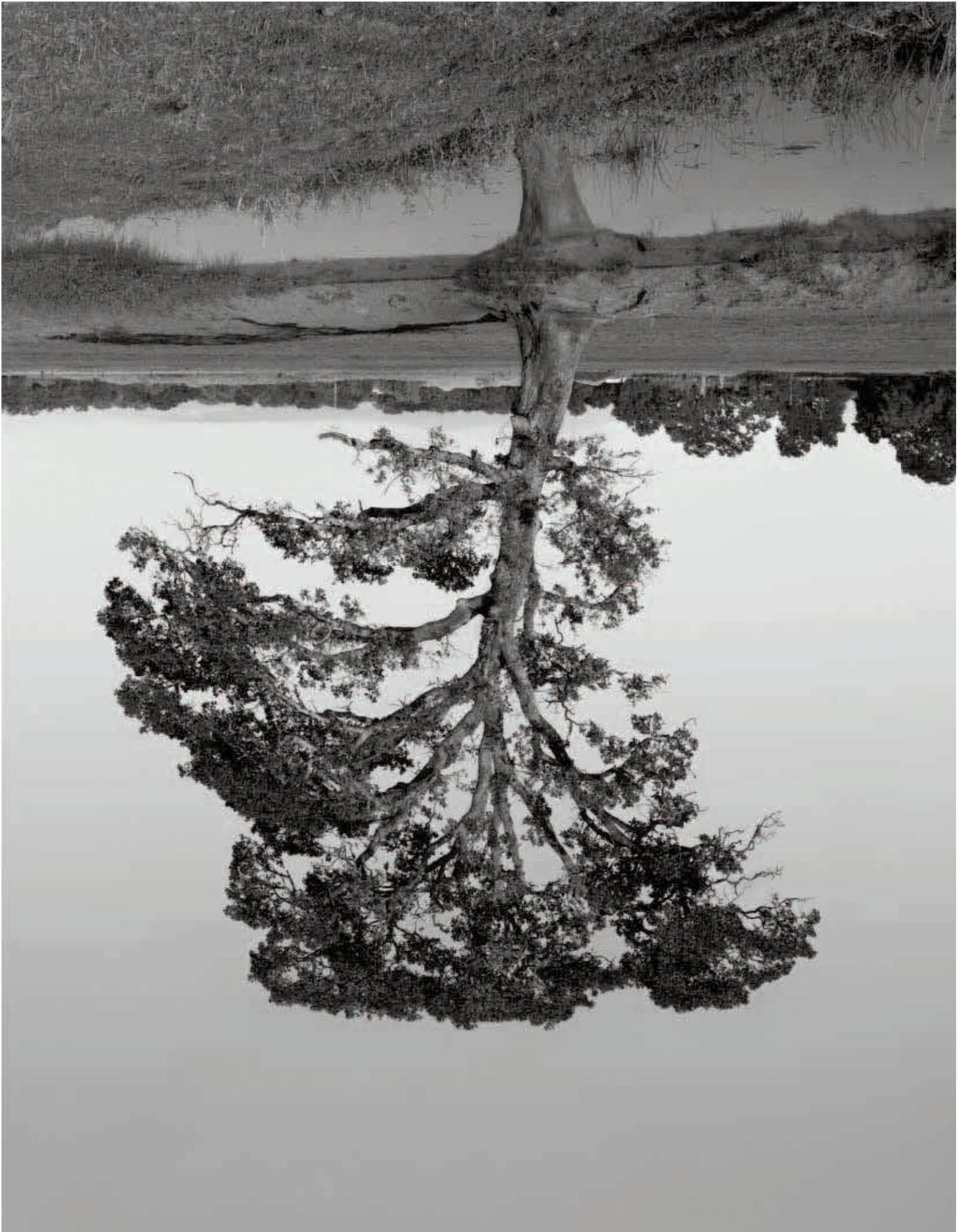




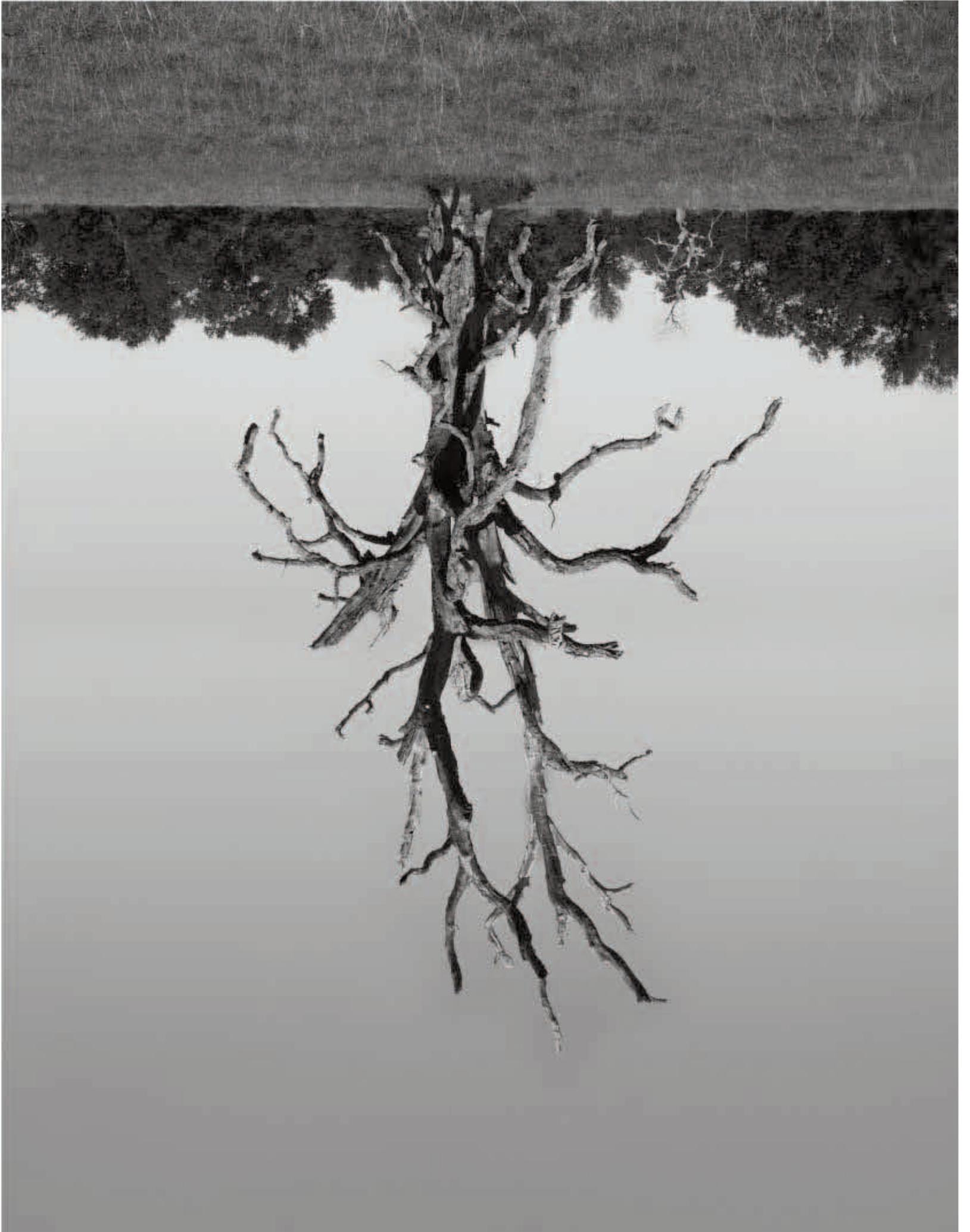
Oak Tree, Red Bluff 4, 1993–2000



Oak Tree, Red Bluff 5, 1993–2000



Oak Tree, Red Bluff 6, 1993–2000



Oak Tree, Red Bluff 7, 1993–2000





Oak Tree, Red Bluff 8, 1993–2000



Authors

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A doctor by training, he has worked in the fields of research and programming in the areas of public health, social welfare and normative support for national and regional governments. He is the director of the Urban Health Resource Centre in New Delhi, a nonprofit organization that works to improve the health, nutrition and welfare of the inhabitants of underprivileged urban zones, and which played a key role in the National Urban Health Mission which mandates reaching out to all listed and unlisted slums, vulnerable settlements in India. He has been a member of several international committees and panels, member of several Government of India committees and an adviser to the World Health Organization, UN-Habitat, UNFPA. He teaches public health from a multidisciplinary perspective at Johns Hopkins University Bloomberg, Washington University, University of California, Berkeley, TERI University, Institut d'Etudes Politiques Sciences Po, Paris, and is past president and executive board member of the International Society for Urban Health. Recipient of the AXA Outlook Award 2014, nomination-based award by Paris-based AXA Research Fund, and of the Rotary Vocational Service Award for his services towards the betterment of the underprivileged in 2015.

Michael Batty

This British urbanist and geographer is a professor of The Bartlett School of Architecture at University College London, where he directs the Centre for Advanced Spatial Analysis (CASA), whose research is centered on computer-based models of cities. These studies have been published in several books such as *Cities and Complexity*, which won the William Alonso Prize at the North American Regional Science Association Annual Conference (NARSC), and *The New Science of Cities*, as well as the blogs www.complexcity.info and www.spatialcomplexity.info. He is the editor of *Environment and Planning B*, and in 2013 was awarded the Prix International de Géographie Vautrin-Lud, known as the “Nobel Prize” of geography.

Mike Berners-Lee

An expert in carbon emissions, the scale of climate change and the sustainability agenda, he is the founder of Small World Consulting. He has written the books *How Bad Are Bananas?* and *The Carbon Footprint of Everything*, and has coauthored *The Burning Question*, among other books on the environment. He is a professor at the Institute for Social Future of the Lancaster University, where he studies the great challenges for sustainability in the twenty-first century. He contributes to various media and has worked in areas related to energy and emissions for various organizations in the public and corporate sectors.

Paolo Bifani

Italian economist, former senior officer of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), United Nations Environment Programme (UNEP), United Nations Conference on Trade and Development (UNCTAD) as well as consultant with other UN agencies such as the Food and Agriculture Organization of the United Nations (FAO), the World Intellectual Property Organization (WIPO), and the Interamerican Bank For Development (IDB), the OECD, the Commission of the European Union, and the International Labour Office (ILO). As a professor has been associated with universities in Spain (UAM), Mexico (Universidad de Guadalajara, UNAM) Switzerland (Institut de Hautes Etudes Internationales et du Développement), Chile, Colombia, Costa Rica and Cuba. He is the author of *Medio ambiente y desarrollo* and *La globalización: ¿otra caja de Pandora?*, and has coauthored nine other books, including *Technology, Trade Policy and The Uruguay Round*; *Global Land Uses and Changes*; *Biotechnology a Hope or a Threat?*; *Sociedad, Cultura y Desarrollo Sustentable*; and

Trade and Environment Review 2016: Fish Trade. He has also published more than eighty articles in specialized magazines.

Boomoon

The South Korean photographer Boomoon gave up painting in the 1970s to study photography at Chung-Ang University in Seoul. At the time he focused on black and white street photography, attesting to the rapid transformation of Korean society through contrasts between rural and urban life. In the 1980s he began shifting towards more abstract compositions devoid of any human presence, and it is for these that he is now renowned around the world. His work has been shown at the Flowers Gallery in London and New York, the Forum für Fotografie in Cologne, the Miami Art Museum, the Yokohama Museum of Art and the Daegu Art Museum.

Nick Cobbing

Cobbing's vocation for photography originates in his interest in nature and his determination to help preserve it. His work focuses on the landscapes of the Arctic and Antarctic, and on the effects of climate change in these zones. He is a contributor to *National Geographic*, *Geo*, *The Sunday Times* and the BBC. His work has won major prizes such as the World Press Photo, Pictures of the Year and American Photography awards, and has been exhibited at many galleries and institutions such as the Parliament in Stockholm and the US Capitol. He has also made films produced by the Look Three Festival of Photography and *National Geographic* magazine.

Thierry Cohen

Has devoted himself professionally to photography since the mid 1980s, when he began to explore the use of digital techniques. Specializing first in editorial portraits, since 2006 he has focused on his own personal work. In his series *Binary Kids*, from 2008, he reflected on the future of the new generations confronted with digital technologies. Since 2010 he has toured the world with his camera, from great megalopolises to solitary deserts, to create the *Darkened Cities* series, which imagines what cities would be like without light pollution. His work has been exhibited at the Palais in Tokyo, the Musée de l'Homme in Paris, the Danziger Gallery in New York, and the official selection of Le Mois de la Photo.

Raymond J. Cole

Professor at the University of British Columbia (Canada), he has taught environmental aspects of building design for the past 40 years and holds the designation of University Distinguished Scholar. He is former director of UBC's School of Architecture and Landscape Architecture and immediate past-director of the university's Centre for Interactive Research on Sustainability. He is an honorary member of the Architectural Institute of British Columbia and a Fellow of the Royal Architectural Institute of Canada. He has won considerable recognition and numerous academic and professional distinctions for his teaching and research activities, including awards from the North American Association of Collegiate Schools of Architecture, US Green Building Council, Canada Green Building Council and World Green Building Council.

Mariana Correia

Holds a doctorate in heritage conservation from Oxford Brookes University, a diploma in earthen architecture from CRATERRE-ENSAG, France, and master's degree in architecture from the Architecture Faculty of the University of Lisbon (FAUTL). She is president of Escola Superior Gallaecia, Portugal, director of Ci-ESG Research Center, and project leader of FCT SEISMIC-V and the European research projects VerSus and 3dPast. She is an ICOMOS international consultant of world heritage sites. She is also a board member of the Iberian and Latin American Proterra network; president of the Steering Committee of the Mali Earthen Architecture Center from Aga Khan Trust for Culture (2015–2020); Steering Committee member of the program WHEAP-UNESCO (2012–2015); Peer Review

Committee member of the Seismic Retrofitting Project (SRP) from Getty Conservation Institute (2013–2017); a member of the board of trustees of the Portuguese Heritage Foundation Convento da Orada and the Spanish Heritage Foundation Antonio Font de Bedoya; and cofounder of the Iberian Prize on Vernacular Architecture Research.

Albert Cuchí

With a degree in architecture from the Escuela Técnica Superior de Arquitectura in Barcelona, he is a tenured lecturer and researcher in the Department of Architectural Constructions at the Escuela Técnica Superior de Arquitectura del Vallès of the Polytechnic University of Catalonia (UPC). His research focuses on the relations between architecture and sustainability from the point of view both of the development of a new vision in the architectural field and of the creation of tools that will allow this vision to be applied. He understands sustainability as the need to close material cycles in the technical processes that satisfy human requirements, and the objective of Cuchí's work in this respect is the study of the processes that determine inhabitability—the basic social purpose of architecture—and its application to the various areas in which the architect makes decisions. Some of his most important works are *Parámetros de sostenibilidad* (2003), *Arquitectura i sostenibilitat* (2005), *Las claves de la sostenibilidad* (2007), and the report *Sobre una estrategia del sector de la edificación frente al cambio climático*.

Ahmed Djoghlaif

The former executive secretary, until 2012, of the Convention on Biological Diversity within the framework of the United Nations Environment Programme (UNEP), he has played a major role in promoting biodiversity at the top of the political agenda of the United Nations Organization. He was previously assistant executive director of UNEP and director of the Global Environment Fund Division. He also acted as cochair of the preparatory committee of the Paris Conference, rapporteur general of the preparatory committee of the Rio Conference on environment and development, and vice president of the negotiating committee of the desertification convention. He has studied at prestigious institutions such as the University of Nancy in France, where he took his doctorate in political sciences; St. John's University in New York, where he earned a master's degree in political and information sciences; and the University of Algiers, where he obtained his bachelor's degree in law. He is currently an adviser to the World Future Council, an organization formed by personalities of recognized ethical stature that represents the interests of future generations by placing them at the center of political decisions. He is the founder and honorary president of the Friends of the Green Wave, an educational campaign that seeks to engage youth and children.

Suzanne Goldenberg

A former correspondent on environmental topics in the United States for *The Guardian*, she spent years as a reporter in areas of conflict, earning several prizes for her work in the Middle East. She has also reported from the most remote places in India and Pakistan, including the world's highest battlefield, the Siachen Glacier. In 2003 she covered the American invasion of Iraq from Baghdad. She is the author of *Madam President*, which deals with the historic career of Hillary Clinton and her attempt to reach the White House.

Rodney Graham

After studying history of art, anthropology and French and English literature, he developed his artistic abilities in the fields of film, music, photography, video and literature. Together with Ken Lum, Jeff Wall and Ian Wallace, he is a member of the Vancouver School of conceptual artists. His works are found in the collections of the National Gallery of Canada, the Art Gallery of Ontario and the Vancouver Art Gallery. He has had exhibitions at the MACBA in Barcelona, the Museum of Contemporary Art in Los Angeles, the Whitechapel Art Gallery in London, the Hamburger Bahnhof in

Berlin, and the Kunsthalle in Vienna. He has also taken part in the Sydney and Lyon Biennials, the Whitney Biennial in New York, and the 47th Venice Biennial, where he represented Canada.

Marek Harsdorff

An economist specialized in development cooperation and the environment. With an in-depth knowledge of the economic dynamics between employment and environmental policies, Harsdorff argues linking social, economic and environmental research to effective policy-making with the view of attaining mutually supportive solutions for sustainable development rather than conflicting ones. He currently works as an economist and policy advisor at the International Labour Organization's Green Jobs Programme, active in more than thirty countries to ecologize their economies through job-led green growth strategies. He is providing policy advice and directing technical cooperation programs for the creation of green jobs.

Naoya Hatakeyama

The Japanese photographer Naoya Hatakeyama studied at Kiyoji Otsuji and finished his training at the University of Tsukuba. Since then he has lived in Tokyo, a city that has provided the model and inspiration for his work, which focuses on the relationship between nature and the city. Hatakeyama's photographs are found in the collections of the National Museum of Modern Art in Osaka, National Museum of Modern Art in Tokyo, Metropolitan Museum of Photography in Tokyo, Museum of Fine Arts in Houston, Yale University Art Gallery, Swiss Foundation for Photography, Maison Européenne de la Photographie in Paris, and the Victoria & Albert Museum in London.

Arab Hoballah

From January 2015 to the end of 2016 Arab Hoballah was the director of Sustainable Lifestyles, Cities and Industry for the United Nations Environment Programme (UNEP). He has also been the director of Sustainable Production and Consumption since 2005, having previously occupied important positions for more than fourteen years in the Mediterranean Action Plan, all within the UNEP program. He has launched and supervised a number of initiatives and joint partnerships in the fields of construction, cities and tourism. He has been actively involved in the preparations for the United Nations Conference on Sustainable Development, also known as Rio+20 as well as the Habitat III Summit.

Daniel Innerarity

A tenured lecturer of political and social philosophy, Ikerbasque Researcher at the University of the Basque Country, and director of the Institute for Democratic Governance, he has also been a guest lecturer at various universities, including recent spells at the Robert Schuman Centre for Advanced Studies at the European Institute in Florence, Georgetown University and the London School of Economics. He is director of associated studies for the Fondation Maison des Sciences de l'Homme in Paris. His latest books include *La política en tiempos de indignación*, *La democracia del conocimiento*, (winner of the 2012 Euskadi Prize for essays), *La humanidad amenazada: gobernar los riesgos globales* (with Javier Solana), *La sociedad invisible* (winner of the 2004 Espasa Prize for essays), and *La transformación de la política* (winner of the 2003 National Literature Prize, essay section). He contributes regularly to *El País*, *El Correo*, *Diario Vasco* and *Claves de razón práctica*. In 2013 he was awarded the Príncipe de Viana Prize for Culture by the Regional Government of Navarre. The French magazine *Le Nouvel Observateur* included him on a list of the world's twenty-five great thinkers.

Domingo Jiménez Beltrán

The former Environment and Public Works counselor on the Spanish Permanent Representation to the European Union, he then took over as head of the Division of Health, Safety and Quality of the European

Commission. Until 2002 he was the first executive director of the European Environment Agency based in Copenhagen, and he has held many important positions in both the European Commission and the Spanish government. An industrial engineer by training, he acted in an advisory role for the president's Economic Office and as director of the Sustainability Observatory in Spain before throwing in his lot with clean energies as the head of the Fundación Renovables, an organization devoted to accelerating change in the energy model. He is currently the chairman of the Fundación Desarrollo Sostenible and the Institute for European Environmental Policy in London. He has been the recipient of many awards, among them the 2007 National Environment Prize.

Yolanda Kakabadse

This Ecuadorean conservationist of Georgian extraction first became interested in environmental matters after finishing her studies in educational psychology at the University of Quito. In that city, she was one of the promoters of the Fundación Natura, an organization in which she acted as executive director from 1979 to 1990. At the Rio Earth Summit, she provided liaison with nongovernmental organizations. She was the driving force behind the creation in 1993 of the Fundación Futuro Latinoamericano, chairing the organization until 2006. Afterwards she also had spells as the president of the World Wildlife Fund (WWF) and the International Union for Conservation of Nature (IUCN). Kakabadse is moreover a board member of the Ford Foundation and the Holcim Foundation for Sustainable Construction, as well as a member of the International Earth Charter Commission.

Aisa Kirabo Kacyira

Deputy executive director and assistant secretary-general of UN-Habitat providing critical leadership to promote sustainable cities and human settlements globally. Previously, Dr. Kacyira held various government positions including governor of the Eastern Province of Rwanda, mayor of Kigali and an elected member of parliament. Dr. Kacyira is also a former president of the Rwanda Association of Local Government Authorities, former president of the Eastern African Association of Local Government Authorities, and former vice president of the United Cities and Local Governments of Africa.

Víctor Lapuente

Holds a doctorate in political science from Oxford University and the Instituto Juan March, and a master's degree in public administration from the Autonomous University of Barcelona, the Universitat Pompeu Fabra and ESADE. This lecturer and researcher specializes in the comparative analysis of public policies, the functioning of state administrations, and the causes and consequences of corruption. He currently works with the Quality of Government Institute at the University of Gothenburg. He is a member of the Piedras de Papel group (eldiario.es) and contributes regularly to *El País* and other media.

Sze Tsung Nicolás Leong

An Anglo-American photographer, he was born in 1970 in Mexico City, where he spent part of his childhood. He studied at the Art Centre College of Design in London, the University of California, Berkeley, and the University of Harvard. Some of his pieces form part of the permanent collections of the Metropolitan Museum of Art, MoMA, and the Victoria & Albert Museum. His work has been exhibited at the Museo de Arte Contemporáneo in Monterrey, Mexico, in collective shows at the Calouste Gulbenkian Foundation in Lisbon, at the 2006 Havana Biennial, at the High Museum of Art, and at the 2004 Taipei Biennial.

Todd Litman

Founder and executive director of the Victoria Transport Policy Institute, an independent research organization located in Victoria (Canada) that seeks to improve transport planning and policy by

means of innovative and practical solutions, such as improving resource-efficient alternatives to private car travel, and more accessible community design. Litman has worked on numerous studies evaluating transportation costs, profits and innovations. He authored the Online TDM (Transport Demand Management) Encyclopedia, and numerous other publications concerning transportation innovations. He is a regular speaker at symposia on these subjects all over the world.

Joan MacDonald

A Chilean architect, she specializes in urban and housing policies. She was undersecretary of Housing and Urban Planning of the Republic of Chile. MacDonald proposes redefining the profession of the architect, whose clients, she maintains, should be the thousand million people in the developing countries who need housing solutions. She has carried out numerous research projects and consultancies for organizations and institutions such as UNESCO and the Economic Commission for Latin America and the Caribbean, and she has published approximately thirty books and articles. Her academic record and outstanding humanistic career as an architect have earned her two National Prizes from the College of Architects and University of the Republic of Chile respectively.

Eduardo Martínez de Pisón

Emeritus professor of geography at the Autonomous University of Madrid, winner of the National Environment Prize, and author of more than 550 publications, he is the director of the Landscape Institute of the Fundación Duques de Soria, and has taken part in geographical expeditions to the North Pole, Alaska, Siberia, the Gobi and Taklamakan Deserts, the mountains of Central Asia, the Silk Route, the Himalayas and Tibet. He has been a member of the Spanish UNESCO MaB committee and a correspondent for the World Glacier Monitoring System. He is a trustee of Ordesa and Monte Perdido National Park, Sierra de Guadarrama National Park, and Teide National Park.

Steve McCurry

A famous American photojournalist known especially for the "Afghan Girl" photograph that appeared in *National Geographic* in 1985. He began film studies at Pennsylvania State University, but finally earned his diploma in performing arts. His interest in photography was the result of his collaboration with the university newspaper, *The Daily Collegian*. He later devoted himself to photojournalism, starting his career with the war in Afghanistan. He subsequently continued covering international conflicts, including the Iran-Iraq war, the strife in Beirut, Cambodia and the Philippines, the Gulf War and Afghanistan. His work has been published in journals around the world. He contributes to *National Geographic* and is a member of the Magnum agency.

James Mollison

A Kenyan photographer raised in England, where he studied art and design at Oxford Brookes University, and afterwards film and photography at the Newport School of Art and Design. He moved to Italy to work for Benetton, and since 2011 has been the creative editor of the brand's magazine, *Colors*. His work has been published in many prestigious journals, including *Colors*, *The New York Times Magazine*, *The Guardian Magazine*, *The Paris Review*, *GQ*, *New York Magazine* and *Le Monde*.

María Novo

A doctor in philosophy and education sciences and holder of the UNESCO Chair in Environmental Education and Sustainable Development, she has been teaching and researching for thirty years in the field of environmental education, the environment and sustainable development. She is a member of the board of directors of the Spanish Chapter of the Club of Rome, director of the Ecoarte project for the integration of science and art in the treatment of

environmental matters and president of the Asociación Slow People. She is also the author of twenty-six books, including treatises and essays, poetry and fiction, and she has been awarded the international N'aitum Prize for her professional career.

Firdaous Oussidhoum

A Moroccan architect and urbanist, and a lecturer of philosophy of architecture, a discipline that allows her to study human development through sustainability and culture. She is a member of the UNESCO Chair in Intermediary Cities: Urbanization and Development, and the secretary general of the Global Forum of Intermediary Cities of the United Cities and Local Governments (UCLG) corporation. She has been a member of the International Union of Architects and is the director of international relations of the African Union of Architects, whose objective is to build bridges with national and international institutions in a new South–South and North–South dialogue that would lead to sustainability. As such, she is currently assisting mayors and institutions in sustainable development strategies.

Teresa Ribera

The director of the Institute for Sustainable Development and International Relations (IDDRI) in Paris, an institution for which she was previously an international adviser on climate policy. From 2008 to 2011 she was the Spanish government's secretary of state for Climate Change, with responsibilities for environmental and climate policies in conjunction with the State Meteorological Agency. She belongs to the State Civil Administrations Corp. She has also been a lecturer at the Autonomous University of Madrid. She frequently collaborates with various think tanks and nonprofit organizations, as well as with various international institutions. She is a member of the board of the Stockholm Environment Institute, the Institut pour la Recherche du Développement, and the Leadership Council of the United National Sustainable Development Solutions Network (UNSDSN), of whose Spanish chapter she is copresident. She chairs the Advisory Council of the Momentum for Change initiative within the United Nations Framework Convention on Climate Change.

Jeffrey D. Sachs

An American economist specializing in sustainable development, he is an adviser on sustainable development to international organizations and governments, and until 2016 was the director of the Earth Institute at the University of Columbia. A professor of economics at Harvard from 1980 to 2005, he was the director of the United Nations Millennium Project and advised Ban Ki-Moon during the drawing up of the Millennium Development Goals. His name appeared on *Time* magazine's list of the world's hundred most influential people. *The New York Times* called him "the world's most important economist," and *Le Nouvel Observateur* cited him as "one of the fifty most important leaders of globalization." His outstanding publications include *The End of Poverty* (2005), *Common Wealth: Economics for a Crowded Planet* (2008), *The Price of Civilization* (2011), *To Move the World: JFK's Quest for Peace* (2013), and *The Age of Sustainable Development* (2015). He also contributes to major newspapers and journals, including *The New York Times*, London's *Financial Times* and *The Economist*.

Sven Teske

The research principal of the Institute for Sustainable Futures (ISF) at the University of Technology Sydney (UTS), he has published more than fifty special reports on renewable energy systems and their integration in the market, including the Global Energy Revolution scenario series and the market perspectives for Global Wind Power "Global Wind Energy Outlook". He also was a lead author for the special report of the Intergovernmental Panel on Climate Change (IPCC) on renewable energies, published in 2011, and he is a member of the group of consultants to the Japanese Renewable Energy Institute. Teske has also been on the reviewer for the International

Energy Agency's annual report on the World Energy Outlook (WEO), and moreover has experience in practical small-scale developments. In 1999, he founded the first power utility organised as a cooperative in Germany's electricity market. For ten years he was the director of Renewable Energies for Greenpeace, leading five editions of the project *Energy [r]evolution: A World Sustainable Energy Outlook*, with joint research by the German Aerospace Center, the Global Wind Energy Council, and various nonprofit organizations.

Mary Evelyn Tucker

Senior lecturer and researcher at Yale University. Together with her husband, Professor John Grim, she is the codirector and cofounder of that university's Forum on Religion and Ecology, and teaches on the joint program of the School of Forestry and Environmental Studies and the Divinity School in New Haven. She has written and published nearly twenty volumes and hundreds of articles. A pioneer in the field of religion and ecology, her work has been distinguished with many prestigious prizes for ecology. She was moreover a member of the international council for the United Nations Earth Charter.

Anne Whiston Spirn

Landscape architect, photographer and academic, as well as the award-winning author of books on landscaping, her work is devoted primarily to the promotion of communities of sustainable life. She studied history of art at Harvard University, where she graduated with honors in 1969. In 1974 she took the master's degree in landscape architecture at the University of Pennsylvania, and since 1987 she has directed the West Philadelphia Landscape Project, devoted to the integration of landscaping, community development and urban rainwater management. Throughout her long career, Spirn has received numerous scholarships and prestigious awards, including the Guggenheim Fellowship and the President's Award of Excellence from the American Society of Landscape Architects. She was a finalist in the 2002 National Design Award, and won the Japan's International Cosmos Prize in 2001 for her "contributions to the harmonious coexistence of nature and mankind." Since 2000 she has taught landscape architecture and planning at the Massachusetts Institute of Technology (MIT).

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