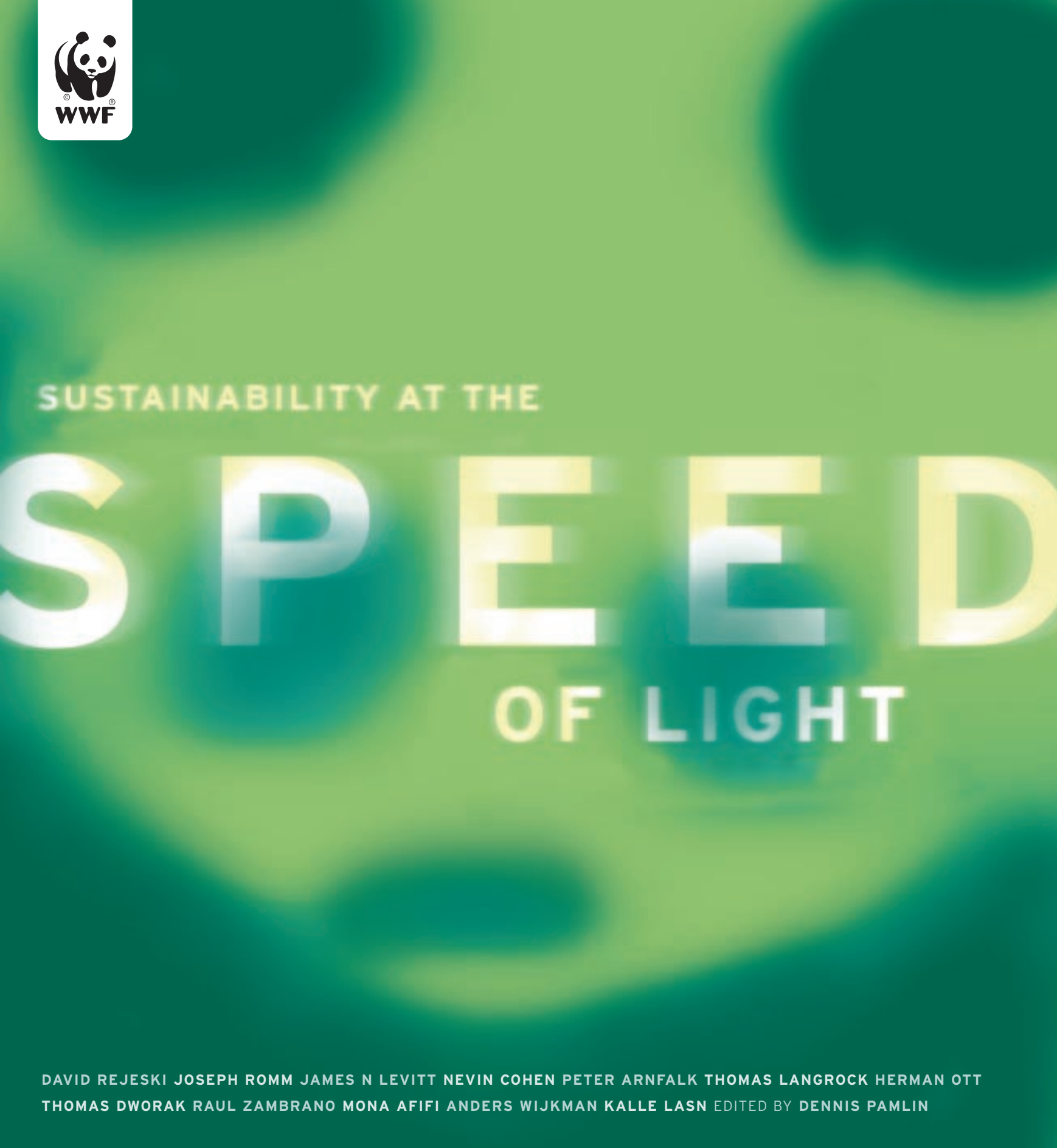

DAVID REJESKI JOSEPH ROMM JAMES N LEVITT NEVIN COHEN PETER ARNFALK THOMAS LANGROCK HERMAN OTT
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SUSTAINABILITY AT THE SPEED OF LIGHT

OPPORTUNITIES AND CHALLENGES FOR TOMORROW'S SOCIETY

EDITED BY DENNIS PAMLIN

FOREWORD

It is in the context of the state of emergency constituted by the ecological catastrophe threatening our planet that we should approach Information and Communication Technology (ICT). ICT is in many ways a unique technology. It has the characteristic of a threshold technology, with the potential to rapidly change the whole structure of society and reshape the way we organise our economy, in much the same manner as did inventions of the last century such as the internal combustion engine. With its growth, ICT will have a major impact on how we live, work, spend our leisure time and even think. These characteristics make ICT impossible to ignore if we want to shift towards a sustainable society.

Many of the world's current ecological, social and economic trends are unsustainable, and some of the most beautiful places on earth are being destroyed. A large number of species are threatened with extinction, and we see pollution contaminating the earth, the atmosphere, freshwater and the oceans, which ultimately sustain life here on earth. This is happening at the same time as we produce more goods then ever before, whilst knowing more about the linkage between the way our economy works and the unwanted consequences.

ICT is a tool that constitutes a new infrastructure that will change the way our societies function, and its technical applications will give us totally new opportunities to both preserve the best elements of our society, and develop new and better solutions. As a whole, ICT is best viewed as a catalyst that can speed up current trends or contribute to a shift towards sustainable development. No one knows specifically what role it will play in the future, but we know that it will be significant and that our decisions today will influence the direction in which it will develop.

This report is a contribution from WWF to the discussion on the role of ICT in tomorrow's society, a discussion that is too often based more on prejudice than facts. We have tried to describe and summarise the most important challenges for the future, asking some of the best experts in the world to contribute a chapter to describe the future role of ICT for sustainable development in their respective fields. The report should be read as an attempt to bridge the gap between ICT experts and policy makers in politics and business, as well as other stakeholders in society. It is WWFs firm belief that these groups need to talk more frequently and openly to each other if we want to create a sustainable framework for ICT-development.

Finally, it is crucial to highlight that no matter what short-term changes we will see in the economy, ICT will play a crucial role in tomorrow's society. We cannot afford to make the same mistake we made during the last period of rapid industrial change during the first half of the twentieth century, when the existing transportation and energy infrastructure was built. During that period, environmental issues were almost non-existent. This time we must think before the infrastructure is in place and adopt a global perspective so as to ensure that our legacy is beneficial to future generations.

WWF will continue to use its network to influence the discussions about the development of ICT, with the aim of contributing to a change towards a more sustainable direction. However, we cannot make much of a difference on our own, and hope for help from all parts of society towards the ultimate goal of sustainable development. Meanwhile, we will continue our work to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

July 2002

Prof. Lars Kristoferson
Secretary General
WWF SWEDEN

Dr. Claude Martin
Director General
WWF INTERNATIONAL

SPE

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A REPORT ABOUT ICT AND SUSTAINABILITY DENNIS PAMLIN

”Two over-riding trends characterize the beginning of the third millennium. First, the global human ecosystem is threatened by grave imbalances in productivity and in the distribution of goods and services. A significant proportion of humanity still lives in dire poverty, and projected trends are for an increasing divergence between those that benefit from economic and technological development, and those that do not. This unsustainable progression of extremes of wealth and poverty threatens the stability of the whole human system, and with it the global environment.

Secondly, the world is undergoing accelerating change, with internationally-coordinated environmental stewardship lagging behind economic and social development. Environmental gains from new technology and policies are being overtaken by the pace and scale of population growth and economic development. The processes of globalisation that are so strongly influencing social evolution need to be directed towards resolving rather than aggravating the serious imbalances that divide the world today.”
Global Environment Outlook UNEP, 2000

For the past few years, information technology and the so-called new economy have been intensely discussed. Many different views exist, but there is no doubt that over the next couple of years information and communication technologies (ICT) will come to affect and reshape most parts of our society. Whether we like it or not, ICT will radically influence transport patterns, energy consumption, overall resource usage and, to an unknown degree, our culture and even the way we perceive the world, our relationship to it, and our actions as dictated by these new mores.

Although ICT will have an enormous effect on tomorrow’s society, surprisingly little research has been conducted regarding its future environmental and social consequences. Most of the work that has been done has reached one of two conclusions: either ICT will bring only good things, from solutions to world hunger and the elimination of all transportation problems to a revitalised democracy; or ICT will bring nothing but problems, accelerating resource consumption, introducing new toxic materials and resulting in greater inequity by introducing a digital divide that will worsen the already unequal distribution of wealth and influence.

The first challenge, if we want to tackle the challenges surrounding ICT for the future, is to go beyond this polarised perspective.

WHAT IS ICT?

If we accept that ICTs potential development will neither be all good nor all bad, and that the future depends on choices made in our society today, we must then try to grasp what impact ICT will have on sustainable development and how we may formulate sustainable ICT solutions. But first of all we must understand what ICT is, a question that is more difficult to answer than one might think.

Even from a narrow technological perspective, ICT is hard to define. One example is the definition of ICT-products of the Organisation for Economic Cooperation and Development (OECD):

> "For manufacturing industries, the products must:
> - be intended to fulfil the function of information processing and communication, including transmission and display; or
> - use electronic processing to detect, measure and/or record physical phenomena, or to control a physical process.
>
> For service industries, the products must:
> - be intended to enable the function of information processing and communication by electronic means."
>
> http://www.oecd.org/dsti/sti/it/stats/defin.htm

This definition might help us to define different ICT products, but in order to study ICTs relation to sustainable development we need to go beyond this "one by one" and, existing product perspective, which make any attempt to find a simple definition of ICT more complex. The closest we can get to a definition of ICT is as follows: Any product or system that communicates, store and/or process information.

We therefore need to examine what different roles both existing and future ICT products might have, as well as trying to understand the potential consequences of different applications and networks of ICT products, often called ICT-systems. In doing so we are confronted with two problems.

First, ICT is a field in rapid and constant development. Almost every day, new technologies are introduced and more people and goods are equipped with technology that makes it possible for them to communicate rapidly and easily. Secondly, products that used to be "isolated" are becoming integrated in

an increasingly dense communication web.

As a result of this technological change, there is a global increased communications capacity made up of more communicating parts across the planet, thus creating a more comprehensive and integrated network. Trying to understand ICTs relationship to sustainable development therefore requires an analysis of ICT on two different levels: that of isolated equipment, that process information and/or is involved in communication, gaining new capacity; and that of the integrated network system as a whole. It is important to understand that the network system changes as each new element is connected, and each new connection enhances the whole, with the total sum being greater than the sum of the parts. However, in order to address the sustainability aspect of the development of the network we must also pay close attention to the people, sectors and areas that are left outside and cannot enjoy its benefits.

Only a few years ago, ICT was something that was primarily related to the making of newspapers, radio and TV. The advent of cheap personal computers and the rapid development of the Internet allows for easy interaction and communication over great distances. More recently, more and more devices, from personal digital assistants to home appliances, are built with the capacity to communicate.

An example of the different kind of impact ICT may have on a limited scale is the by now pretty well known concept of the "intelligent house". Today these houses still exist primarily as experiments, but over time, more and more applications find their way into ordinary homes. In an intelligent house most components of the home, from the heating system to the refrigerator, have the capacity to communicate with each other and with the rest of the world.

A house that can communicate with the rest of the world can be designed to optimise the current system of resource use and help the inhabitants to live in a more sustainable manner, as well as find totally new solutions to age-old habitation problems. Optimising solutions can, for example, include a heating system connected to the weather forecast for optimal heating, and that, jointly with other electrical appliances within the house, can communicate with the power utility to lower energy demand when energy prices are high. A new sustainable solution includes tele-commuting and digital newspapers that would enable us to avoid a polluting daily commute by car, and reduce the need for materials and transportation by downloading information.

Such a house could also help us make more sustainable choices. Refrigerator could be programmed not only to keep track of what food they contain, but

also to recommend a menu based on seasonal organic food grown locally in order to reduce the amount of CO_2 emissions and pesticide use. Of course the "intelligent house" could easily become the "not so intelligent house" if the ICT equipment requires more energy than saved or the equipment is used to increase consumption of goods and transportation.

The intelligent house is only one example of how our world is changing, often without our noticing. It illustrates how a wide range of different possibilities for sustainable solutions will emerge when ICT permeates society as a whole. Stipulating that ICT includes everything that communicates, store and/or process information, and that in the future many more products will be designed to communicate and be used for communication, it is clear that a vast new area opens up for study. However, it is important to bear in mind that anything less than a comprehensive perspective will result in too narrow a perspective that will be of little help if we are serious about ensuring that ICT plays a positive role for sustainable development.

At the brink of dramatic societal changes it is very hard to look beyond the immediate challenges. In this rapidly shifting environment, it is however extremely important to search for new solutions and try to envisage a clear goal. If this is not the case, tensions causing a breakdown in the social fabric will build up in society, tensions that could have been dealt with at an early stage.

We are at the beginning of a technological and economic revolution in which ICT can be compared with the application of electricity and power-driven machinery to manufacturing that spurred the industrial revolution, or even the use of the plough in the agricultural revolution that made large-scale agricultural production possible, leading to the development of agrarian societies. Seen in this broader historical perspective, it is surprising how people can talk about a downtrend for ICT simply because of a drop in the stock market or another comparatively marginal event.

UNDERSTANDING THE RELATION BETWEEN ICT AND SUSTAINABLE DEVELOPMENT

The relationship between ICT and sustainable development has only recently begun to be a topic under academic and scientific discussion, and only a limited number of experts with extensive knowledge on the subject exist. This report consists of nine papers from leading experts within different fields of relevance to the ICT discussion, providing an overview of the topic. Some of the authors are more optimistic and some more pessimistic, but they all agree

that today's decisions are shaping tomorrow's world.

The first contribution, Anticipations, by David Rejeski, puts the question of ICT and sustainability in a broad context, discussing the need to realise the magnitude of the challenges we face. Following this overview, Joseph Romm, in his article The Internet and the new economy, presents different possibilities thanks to which ICT may be used to save energy as society develops along with the new technologies. He presents information about today's situation and also discusses some of the myths surrounding ICT, such as the claim that ICT today is a huge energy consumer.

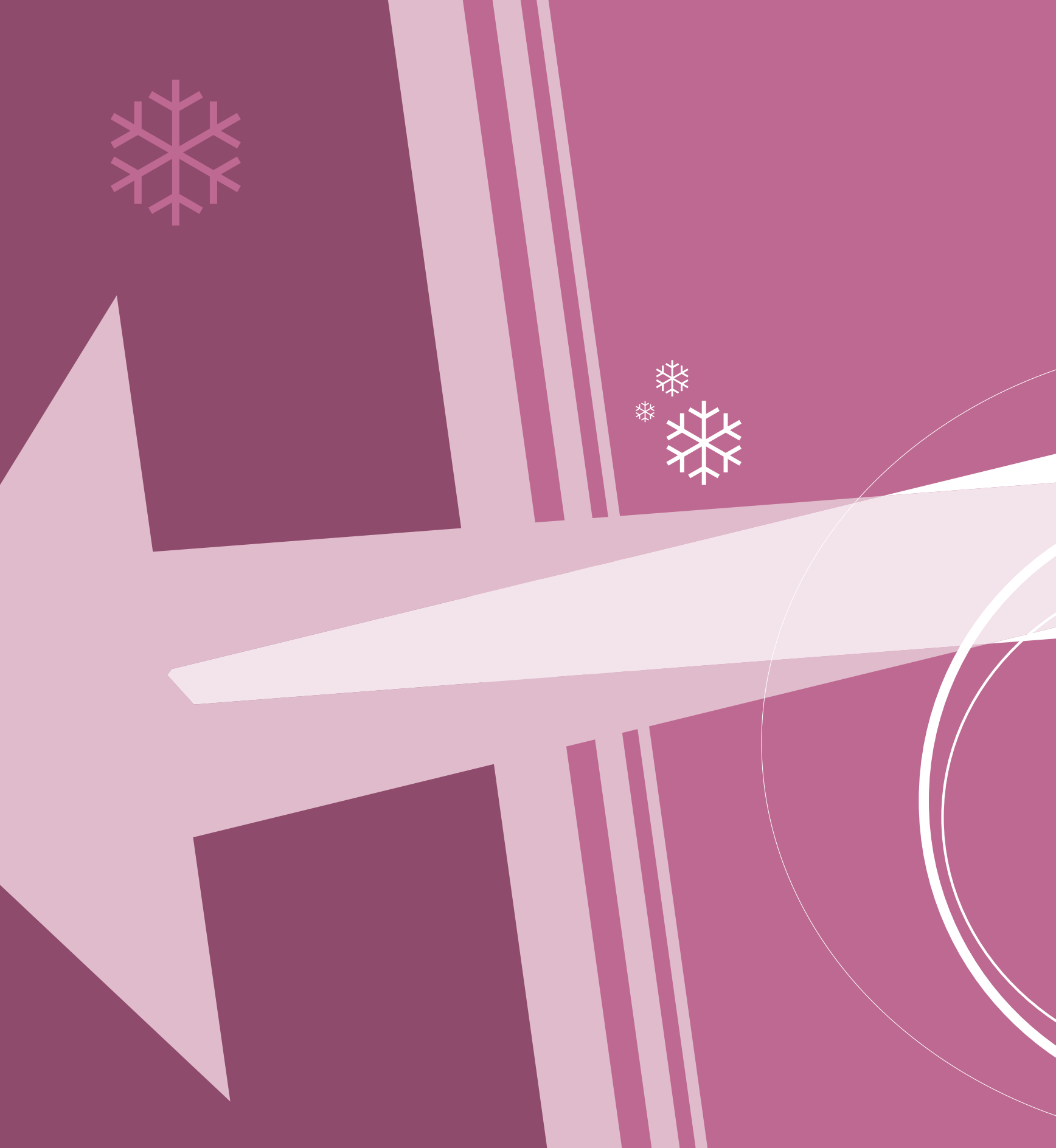
James N. Levitt's third chapter contribution, The Internet as conservation activist, focuses on the uses for ICT in conservation work and puts the role of ICT as a new type of infrastructure into a historical context. The fourth contribution, E-commerce and the environment, from Nevin Cohen, focuses on the application of ICT to commercial ends, both for ordinary consumers (business-to-consumer or B2C) and for companies (business to business or B2B).

The fifth contribution, Can virtual meetings replace business travel?, from Peter Arnfalk, focuses on the different ways and means in which ICT may be used to curb the rapid growth in business travel. The sixth contribution, Environmental Friendly ICT-Products, is written by a team from the Wuppertal Institute, and focuses on solving the potential environmental problems linked with the spread of ICT products in our society and economy. Both the issue of new toxic materials is discussed, as well as strategies for less energy-intensive ICT equipment.

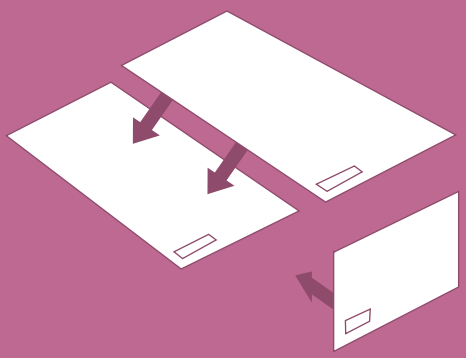
The next two contributions focus on the digital divide. In the seventh article, ICT for development: Facing the policy challenges Raul Zambrano gives an overview of today's challenges and illustrates how the international community has reacted so far. The eighth article, The digital divide and beyond, by Mona Afifi and Anders Wijkman, focuses on the challenges that we must tackle to close this divide, and suggests possible ways forward.

The ninth and last contribution, Citizens or egoistic cyber consumers, is from Kalle Lasn and focuses on the cultural aspects of the development of ICT, discussing the impact of ICT from a perspective where control and content are in focus.

Following these nine contributions is a chapter outlining a structure for approaching ICT and sustainability, in which sustainable principles and strategic areas are presented.



ANTICIPATIONS DAVID REJESKI



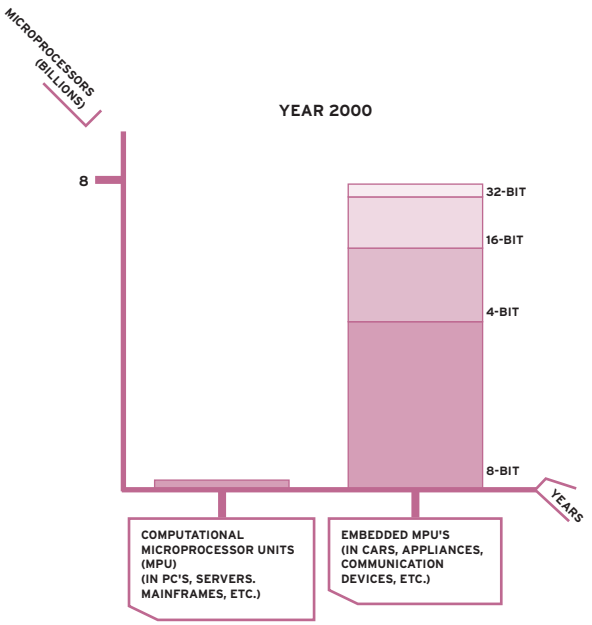
Midway through the industrial revolution, H.G. Wells sat down and attempted to anticipate the future. His reflections, published as a series of articles in the English magazine, The Fortnightly Review, touched on a wide range of technological and social changes: new labor-reducing devices for the home, highways awash in automobiles, the explosion of suburbia, and the emergence of wars beyond the understanding and control of politicians (Wells, 1902).

Let us imagine, for a moment, that we have entered what a number of observers have called the "second industrial revolution," fueled by the emergence of new information and production technologies, supply chain management techniques, and competitive strategies. Like the first industrial revolution, this one will have profound impacts on the environment, work, commerce, and society. This industrial revolution, however, will happen much faster, leaving far less time to consider impacts, unintended consequences, and policy responses.

To understand the opportunities and hazards, we will have to first understand the transformation. The greatest danger may be in drawing artificial distinctions between the old and new economy, and assuming, rather blindly, that this so-called new economy is more environmentally benign and sustainable. In fact, the new economy cannot exist without the old economy. The New World is not about divergence between the old and the new, but fundamentally about convergence. Much of what will fascinate and frustrate us as a society will take place at the points where various worlds converge: the new with the old, the physical with the digital, the virtual with the real, the organic with the inorganic.

These collision points will drive innovation, launch industries, reorganize social relationships, and challenge our traditional notions about what is just or unjust. As various people explore these intersections they will come away with different perceptions, ranging from a coming sustainable nirvana to an approaching world of perilous technological advance. How things turn out for humanity may depend heavily on our ability to perceive the changes, explore their implications, and intervene, when necessary, to shape this emerging future.

Let us begin by imagining a world where the digital and the physical merge. As Neil Gershenfeld at the MIT Media Lab has observed, in the future all things will have a useful physical existence, and a useful logical existence (Gershenfeld, 1999). How might this happen? In fact, right now, most people in industrialized countries live out their lives in perpetual proximity to silicon-based logic. Much of this logic is invisible to us and has little to do with the personal computer on our desk. Instead, it lurks inside our appliances, cars, toys, cell phones, smart cards, and even running shoes. To understand the density of this world, and its potential implications, one must know that only 2 percent of the approximately 8-billion microprocessor units produced last year ended up in computers.



As these microprocessors become increasingly interconnected – with each other, the Internet, and the physical world – they will form pervasive networks that span both space and time. Estimates are that there could be as many as 10,000 telemetric devices per person in the industrialized countries by 2010. As this *second wave of connectivity* unfolds, the Internet will stop being an information highway and become part of a pervasive computational fabric. Freed of the desktop, computing can finally go out into the world where it could potentially benefit those billions of people on our planet who have neither the money nor the inclination to feed, care for, or trouble shoot the PC's that shape our lives.

The next step on this evolutionary path will be the convergence of logic with action. The millions of thinking nodes in this new fabric will start sensing and doing, using pumps, actuators, and sensors. Things that can think will then reach out and gather information about the world around them – temperature, pH, humidity, pressure, fast-slow, up-down, concentrations of chemicals, pollutants, and electrical and magnetic fields. At that point, the Internet stops being dependent on humans for information input and can learn autonomously about its environment. Networked chips and software agents can decide when they need more data and figure out how to find and analyze it (McKay, 1999). Within a decade more things will be using the Internet than people. As Michel Mayer, the head of IBM Pervasive Computing recently noted, "It's going to be more and more machines talking to machines, things talking to things, without human interaction....It's going to be your fridge, your car, your tools, your clothes, doing all those little microelements of tasks." (Gleick, 2001).

This information fabric will weave itself into the biological realm as the organic and inorganic worlds converge. Increasingly, chips may be embedded in living organisms, even humans, using subcutaneous implants and neural interfaces (Warwick, 2000; Kovacs et al, 1994). We may use silicon to make sense of biological and genetic information (DNA chips) or as part of a sensing mechanism (DNA on-a-chip) that could be used to do such things as detecting dangerous substances in our environment (Johnson, 2000). These new capabilities will be built on a sequenced human genome and increasing knowledge of the function of proteins in linking genetic code to biological and physiological processes (Eisenberg et al, 2000).

All this capacity will become increasingly small; invisible to the human eye and senses. Right now, we are close to having an autonomous sensing and communications package in a cubic millimeter (Pister et al, 1999). We will do that

with rather traditional production techniques, not with emerging capabilities to build atom-by-atom at a nanoscale. We are presently crossing the nanoscale divide and that will place our production capacities three orders of magnitude below the size of existing human-made objects. Nanoscale devices may exhibit completely different electrical, optical, and physical properties than their microscale cousins and could interact directly with organic systems (a DNA molecule is about two nanometers in diameter). Certainly within the next ten to fifteen years, nanodevices will become part of our logical and biological world.

Here, in a nutshell, is what we may expect in the next decade, much of it already upon us or on the near horizon.

PHYSICAL AND DIGITAL WORLDS MERGE
SECOND WAVE OF CONNECTIVITY
THOUGHT AND ACTION MERGE
ORGANIC AND INORGANIC MERGE
NANOSCALE DIVIDE CROSSED

Andy Grove at Intel has called changes of this magnitude inflection points, transitions where the rules of the game that drive business and government fundamentally and inexorably change (Grove, 1996). If we look across this array of changes, it makes no sense to speak of an Information Technology revolution without talking about the associated revolutions, and evolutions, in areas such as genetics, biology, and material sciences. It would be like trying to understand the first industrial revolution by focusing only on the steam engine. It also makes no sense to talk of these technological changes without thinking simultaneously about their human and social context (see Brown, 1999). Technology and society will co-evolve, in an endless set of interactions that will shape both technological and social outcomes.

What is emerging is an information and computational fabric of immense complexity and scale interwoven with our social fabric. A number of metaphors have been coined to describe this thinking, sensing, and doing fabric such as an electronic skin or global brain (Gross, 1999, and http://pespmc1.vub.ac.be/Conf/GB-0.html). Historically, this emerging system reflects earlier ideas of people such as the French Jesuit scientist, Pierre Teilhard de Chardin,

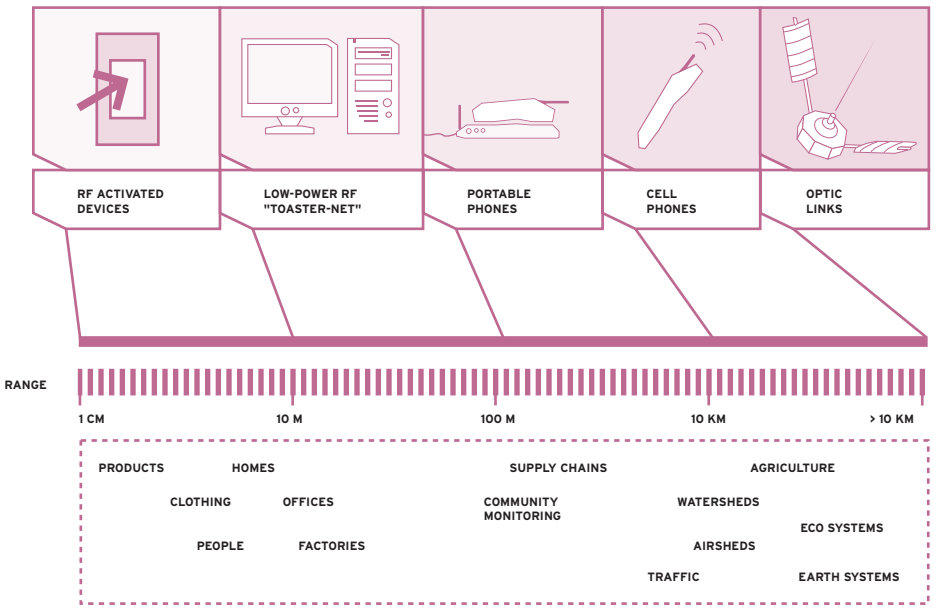
who spoke of a global consciousness, or H.G. Wells, who wrote in the 1930's of the possibility of creating a world brain.

How we design and use this fabric is one of the great challenges of the coming decades, as is thinking about what this fabric may do to us, as individuals and as a society. The promise is distributed sensing, production, and problem solving at a grand scale. Developing this capacity, however, represents a grand challenge for science and engineering. Scaling this fabric up will be a daunting task. The system will reach the point where no one can truly understand it and this will require new ways to achieve control without control. Understanding the potential social, ethical, and legal implications of such a system will represent an even greater societal challenge.

However, once in place, such a system would have some unique emergent properties that may be critical to our search for more socially and environmentally sustainable systems, including the ability to:

- integrate heterogeneous systems including storage, communication, traditional computing, and human processing;
- capture signatures and references between data on a network that will allow better understanding of the complexity of interactions in large systems;
- transmit, with little loss or distortion, information in stored or real time form;
- move from deterministic to stochastic problem solving; and,
- move from sharing information to integrating and coordinating decision making across organizational boundaries on a real time or near real time basis (Rasmussen & Johnson, 1998).

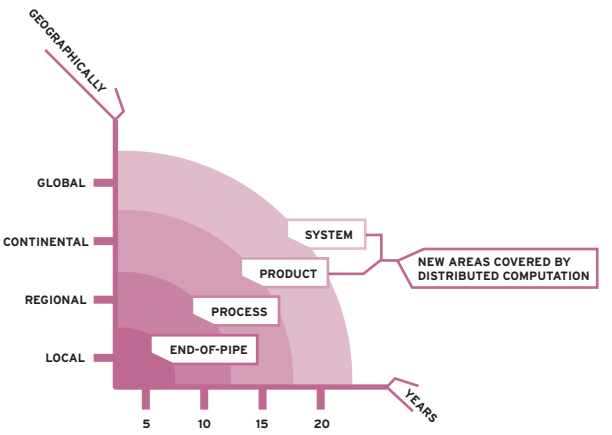
If we could begin to imagine what such an interconnected system might look like, and what parts of our lives and our world it might touch, it might help us to explore potential applications. For such a system to emerge, we must assume that some significant technical issues will be solved. For instance, we need to assume that we can connect together billions, or potentially trillions, of new nodes without creating routing problems; that salutation and discovery software will allow these networked devices to find each other and communicate effortlessly; and that we can find places for these new devices to operate on the radio frequency spectrum. The figure below provides a schematic of what such an information fabric might look like, stretching from a microscale outward, and areas where it might find applications. All pieces of this picture already exist, though some are in rudimentary form and



some are not connected to the rest of the components. This meta-network would be formed of many adaptive and dynamic peer-to-peer networks that could self configure seamlessly based on the needs of users, internal information gathering algorithms, or the external environment.

A system of this scale and density would allow us to address classes of environmental problems that have been particularly difficult to instrument and understand but increasingly important (see graphic below, adapted from Vellinga and Herb, 1999).

The question for those interested in sustainable development is: "How would or could such a system be put to use?" Here are a few possibilities, hardly an exhaustive list.



1. LARGE SYSTEMS ASSESSMENT

One of the obvious uses of such a fabric would be to instrument complex systems and do that at scales that have been difficult or impossible in the past. In many developed countries environmental problems have become more low-level, spatially distributed, and chronic – a very different set of characteristics than those associated with the early phases of environmental protection. Up to this time, it has been very difficult to understand the environmental performance of large socio-technical systems, let alone to co-optimize them for environmental gain. Such systems might include: agro-ecological systems,

power distribution systems, oceans, urban traffic, water and air sheds, or logistics systems.

In addition, the use of wireless microsensors may allow us to gather much better data in hostile or difficult-to-reach environments, such as rain forest canopies, oil spills, forest fires, etc. Such distributed systems could fundamentally change our approach to science and data collection. For instance, if we lay fiber optic cables through the ocean (interconnected with sensor buoys), we change the nature of oceanography, which has historically required us to go to the data, not visa versa. If we empower tens of thousands of bird watchers across the country (or globe) to share their data on bird sitings, we change the nature of ornithology and our understanding of migration (Garreau, 2001). If we use wireless technologies to hook thousands of "citizen scientists" to biologists and taxonomists, we might have a half a chance of cataloging species in our ecosystems (see: EcoWatch at: http://dnr.state.il.us/orep/inrin/ecowatch/). Suddenly, systems that have been too large and expensive to instrument become tractable targets for scientific inquiry.

2. THE NETWORK AS COMPUTER

Imagine for a moment what you could do with 10 billion megahertz of processing power and 10 thousand terabytes of storage, especially if it was free. According to conservative estimates, that is what the world's net connected PC's presently provide and peer-to-peer computing is all about providing those distributed resources to people at little or no cost (Minar & Hedlund, 2001). The oldest and most famous application of this type is SETI@Home, which uses Internet connected computers to search for extraterrestrial intelligence. This system takes advantage of the fact that the central processing unit (CPU) in most computers only works a fraction of the time. SETI@Home now has over 2.1 million computers in the network that have contributed over 300,000 hours of CPU time to the project's research (SETI, 2001).

Intel's new Philanthropic Peer-to-Peer Computing Program uses peer-to-peer technology linking PC's to provide large amounts of computing power to medical researchers searching for new treatments for diseases like leukemia (Intel, 2001). The virtual supercomputer is used to perform a variety of tasks including molecular analysis and drug optimization. Researchers at RAND used a similar approach to run climate change scenarios on CPU time borrowed from colleagues computers (Lempert, 1996).

There is no reason this concept could not be implemented to provide dis-

tributed computation for environmental and ecological research and monitoring (let us call this system SustaintheEarth@Home). An obvious extension of this model would be to combine virtual computation with data collection using distributed sensors embedded in wireless devices and nodes. Surely we could use mobile, dynamic networks of cars and trucks outfitted with sensors to monitor pollution, not just to pollute.

3. DIGITAL SHADOWS

Thirdly, we can begin to explore what happens when we map this evolving and ubiquitous information system onto the existing manufacturing system. Let us imagine that we can provide a unique identity to all objects in the global supply chain, or, put another way, give each object a digital shadow. To do this, we will need around 90 bits of code, more than enough to tag 10^{14} items, and the tags will have to be inexpensive, about a penny a tag. According to Kevin Ashton, Director of the Auto-ID Center at MIT, we are probably two to five years away from reaching these goals (see: http://auto-id.mit.edu/index2.html).

Unlike traditional bar codes, that require sophisticated laser readers to work, these tags can be read using inexpensive radio frequency systems built into our refrigerators, shopping carts, microwave ovens, and garbage cans. Environmental protection can move from managing industries to managing every object, which includes knowing the properties and whereabouts of these objects. Combining logic tags with low cost sensors would allow status monitoring for these objects, for instance, the temperature and humidity history of perishable items or vibration and impact history of fragile goods. Customers could benefit from such a system since they could quickly recognize and sort desired items (using the Internet or hand-held devices) according to criteria such as recycled content, recyclability, energy efficiency, toxics, etc. In terms of life cycle management, complex consumer products with tagged parts could be more easily sorted, de- or remanufactured robotically at lower costs.

A world where every object has a unique identify radically changes the logic for most inventory and warehousing systems, which are the physical manifestations of an information failure. Product tagging would allow us to differentiate stock keeping units based on actual demand patterns and get the right product to the right customer at the right time. At the moment, companies wait from four to thirty days to get data from bar code readers at retailers (Dalton, 2001). Though it might take five to ten years to build and scale up such a system, it could revolutionize the life-cycle management of products.

Reader and Tags.
Courtesy of Texas Instruments RFID Systems.

Traditional Bar Code

The world of product tags will be mirrored by a world of digital markers for the animate world. Over the last five years, advances in biotelemetry have allowed us to use passive integrated transponder tags (or PIT tags) to monitor the activities of a wide variety of species. These tags are normally injected directly under the skin of a fish or animal, remain active for the life of a species, and can be read at ranges of 10-20 centimeters by passive antenna arrays (Armstrong, 1996). Data from these systems is now available in real time and near real time formats over the Internet, allowing both citizens and conservation biologists to track species movements over large geographic areas (see, for instance, the Columbia River DART/Data in Real Time system at: http://www.cqs.washington.edu/dart/help/).

Computer-driven, powder metallurgy press (foreground) with traditional press behind. Courtesy of Mii Technology.

Object with 7 articulating joints from a 3-D printer. Courtesy of MIT Media Lab.

4. UNTETHERED PRODUCTION

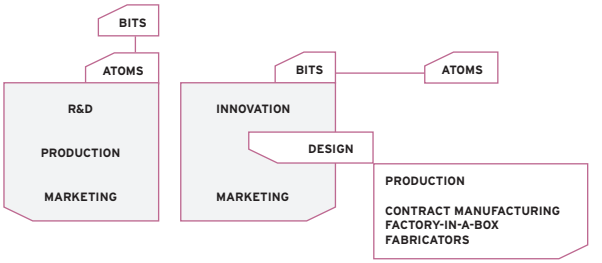
Finally, let us assume that along with a ubiquitous computing and sensing fabric we also have a parallel and complementary revolution in production. Fabrication today is where computation was twenty years ago. It tends to occur in large, centralized facilities and it is only now finding its way out into the wider world (as the personal computer did) at smaller scales that allow customized production of short runs (lot-size-of-one). Take a look at what has happened to that workhorse of the first industrial revolution, the press. New powder metallurgy presses can generated twice the pressure in a fraction of the space and can produce parts fifty percent faster than traditional presses (Kluger, 2000). This is digital manufacturing for the new economy moved onto the desktop and beyond.

But change often moves in two directions. Take the workhorse of the information revolution, the printer, and turn it into a production machine. There are a wide range of small desk-top systems that allow very complex objects to be printed using polymer-based powders.

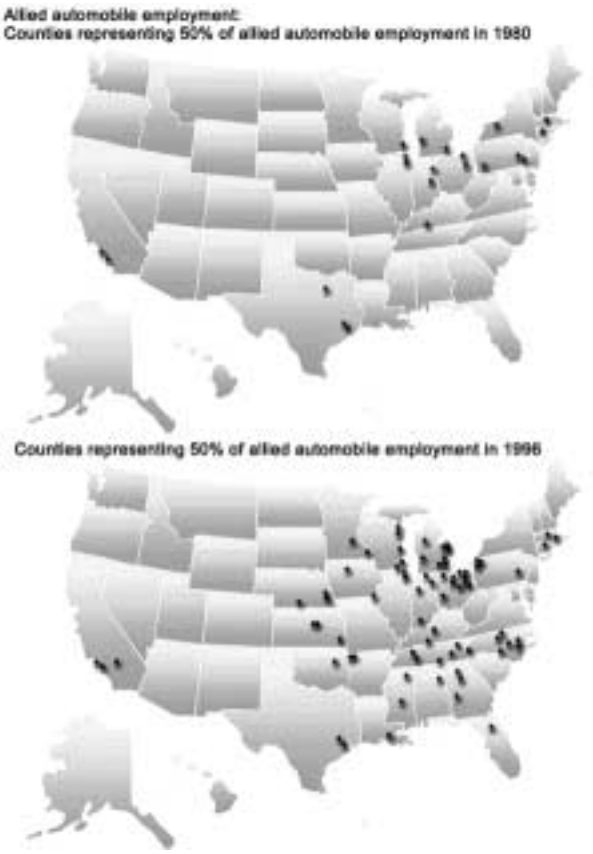
Now we have given this digital fabric the ability to produce things in new ways, to actually manufacture three-dimensional objects. Let us imagine that we can also print logic and print sensors (Mihm, 2000) so that we can manufacture things that think, things that think and act, and things that can make other things (assemblers). In this scenario, we have moved from distributed communication (the Internet as we know it) to a world where massively distributed computation and production interact in new ways – the New Economy meets the New/Old Economy. Two key transformations are occurring. First, we are separating the code of production from production itself, and, sec-

ond, we are making production small, highly flexible, and mobile. When these two requirements are met, companies will have much greater freedom to move from vertical integration to more flexible horizontal systems, to separate bits from atoms and recombine them in creative ways. We will see the emergence of what Tim Stugeon at MIT calls Turnkey Production Networks (Sturgeon, 1997). Companies are already offering mobile mini-plants in 20 and 40-foot containers to make everything from baked goods to welding electrodes.

Turnkey and networked manufacturing will allow companies to delink production from innovation, "deconstruct" their value chains, and reassemble them close to cheap labor, large markets, key customers, etc. (Evans & Wurster, 2000). Firms can shift to open-source models for manufacturing, thereby reducing manufacturing overhead and inventory costs, and postpone various aspects of the production process to the point of final assembly or use.



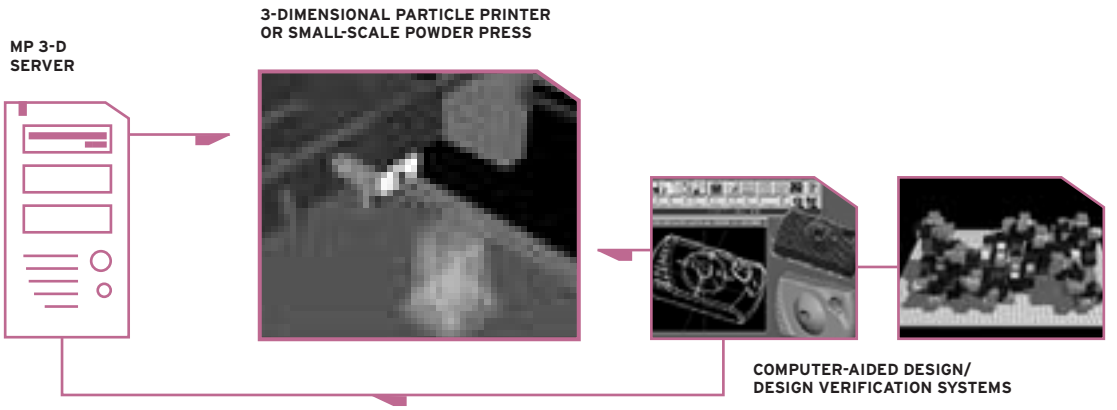
Directionally, this trend is not new. Outsourcing is already changing the geography of production and associated logistics strategies and patterns. In 1980, 50 percent of auto production employment in the United States was concentrated in 16 counties. By 1996, only a third of manufacturing was concentrated in these counties (see maps below, from Clancy & Rejeski, 2000). Much of this new activity is in "greenfields" away from traditional urban manufacturing corridors.



Design verification software now allows us to design logic chips anywhere in the world and ship the production code anywhere, for instance, to a silicon wafer fab in a jungle in Borneo (see Jungle Fab by Doler, 2000). This globalization of design and production is likely to become more and more common, especially for low weight/high value items that can be moved rapidly to market via airfreight.

If we fast forward ten years or so, we could certainly have systems in place that store production codes on servers and allow the code to be downloaded to small scale and personal fabrication devices (we might describe this as an MP 3-D system). Another possibility is to upload production code directly from computer aided design and verification systems. Some researchers are already talking about "Napsterization" of the supply chain, which is built on peer-to-peer computing and will enable real time or near real time data sharing and coordination within the value chain (McAfee, 2000).

As value chains are radically reconfigured, settlement patterns may change. Look at Alliance, Texas, which boasts the world's first industrial airport. The so-called "goods moving city" has an airstrip, big-box buildings for



product assembly (cell phones), and a FedEx hub. Looking out to the year 2020, some people have predicted that "Steel manufacturing that could only be performed in Cleveland will be everywhere. Autos produced only in Detroit's mile-long factories will emerge from knockdown garage assembly shops in the Amazon and East Eighty-sixth Street in New York" (Moody & Morley, 1999). We have a unique opportunity to shape a major industrial transformation in ways that can make it more environmentally sound and sustainable, if we are willing to act rather than wait.

SO WHAT?

The questions raised by this set of transformations are almost endless. For instance, how would environmental codes of conduct work in a system where production becomes radically decentralized and even personalized? What happens when intellectual property moves beyond music to production codes? If I know where most objects are, what can I can infer about their owners? What if I turned distributed computing power to the mining of individual data sets across various domains? How will we as a society react/interact with these changes? Is this emerging infrastructure democratic or, at a most basic level: "How would we know?" (Johnson, 1997).

If we are concerned about these technological developments in terms of sustainability, then we must be concerned about democracy, about equity, and about social impacts. There is no a priori reason to believe this emerging global infrastructure will lift millions from poverty. There is no reason to believe that the digital commons will remain free from the encroachment of private interests and undiminished by free riders living in a highly interconnected, peer-to-peer computing world (see Adar & Huberman, 2000, for a discussion

of free rider effects). We should have no illusions that this many-to-many world provides unfettered access to all the information one could imagine wanting (Introna & Nissenbaum, 2000). The feel-good New Economy may not be any more democratic or socially kind than the old hierarchical structures it purports to replace (Argyris, 2000; Sennett, 1998)

Whether one agrees with Bill Joy's recent account of the future, he was right with his observation that, "Part of the answer certainly lies in our attitude toward the new - in our bias toward instant familiarity and unquestioning acceptance" (Joy, 2000). The danger with large, enabling technological systems is that they will be quickly accepted and their embedded values and flaws will become mapped onto their future applications. In his recent book, Code, Stanford university legal scholar Lawrence Lessig makes the point that our ability to address a host of today's issues around Internet privacy, content, and taxation was determined years ago by a bunch of obscure programmers sitting in a public policy vacuum (Lessig, 1999).

The problem, in terms of sustainable development policy, is that the system we have been exploring will be built long before any extensive dialogue occurs about its larger social purpose and embedded values. By the time questions about environmental impact and social equity are asked, many of these technologies, and the social institutions that support them, will be effectively locked in. In a high clock speed world, technological change will almost always outpace policy innovation and social dialogue (see Fine, 1998, on organizational clock speed). A number of approaches might help address some of these challenges, but none are panaceas.

First, the concept of personal computing provides a poor reference and vantage point for thinking about this emerging world. We need a broader concept of what might be called ecological computing that utilizes the notions of complex adaptive and self-organizing systems in the design and understanding of this evolving information fabric (Brown & Rejeski, 2000). When the personal gives way to the ecological, our traditional notions of how systems operate and to what ends must change accordingly.

Second, complex and interlocking systems of technology at the scale we have been discussing will place an increasing burden of vigilance on every person and institution involved in their design, production, maintenance, and improvement (Tenner, 1996). The intent of the designer, scientist, and eng neer will matter more than ever. Because design lives in a social context, the designers must think in a social, and increasingly, ethical context. As a society,

we can no longer afford to "outsource" the consideration of social and ethical issues to separate institutions and disciplines (Offices of Technology Assessment, bioethicists, etc.). We will need continual reflection, not just one-time assessments. A much broader social dialogue about the implications of these technological advances will be needed though we need to be aware that more connectivity and participation does not automatically mean more democracy (Andersen & Jaeger, 1999; Wilson, 1999).

Finally, we can no longer afford to indulge in a blind enthusiasm for technological advance, expending enormous resources working on lifestyle enhancing gadgets for the developed world. People like Victor Papanek and Buckminster Fuller had it right decades ago when they talked about design for need or design for the real world (Papanek, 1971, 1995). We inhabit a world where four billion people earn less than $1500 a year and most have never made a telephone call. A distributed computational and production fabric could provide these people with telemedicine, distance learning, and microfinancing opportunities, but the interfaces will have to cost pennies to dollars, not hundreds of dollars (Hammond, 2001). We will have to consciously design this evolving system for their needs, not only for the needs of white-collar suburbanites seeking "smart" homes, autos, and the latest in personal digital assistants.

It is not technology that will change the future, but how we shape and apply it. Our choices, as individuals and as a society, are severely limited if we wait until the next electronic gadget lands on our desk. We need to replace the idea of sustainable development with sustainable research and development. Only if we are willing to move from being the consumers of technology to the shapers of technology can any notion of sustainability evolve. Historically, the environmental community has been too reactive to affect our technological future. What is required is involvement in the science and early stage research that will shape our lives in five, ten, or fifteen years. Our enemies in this enterprise will be the weight of history, the inertia of our prior conceptions, and our inability to move across disciplinary and organizational boundaries. Peter Drucker had it right many years ago when he noted that in a world where turbulence dominates, the greatest danger is not the turbulence, but thinking with yesterday's logic. ■

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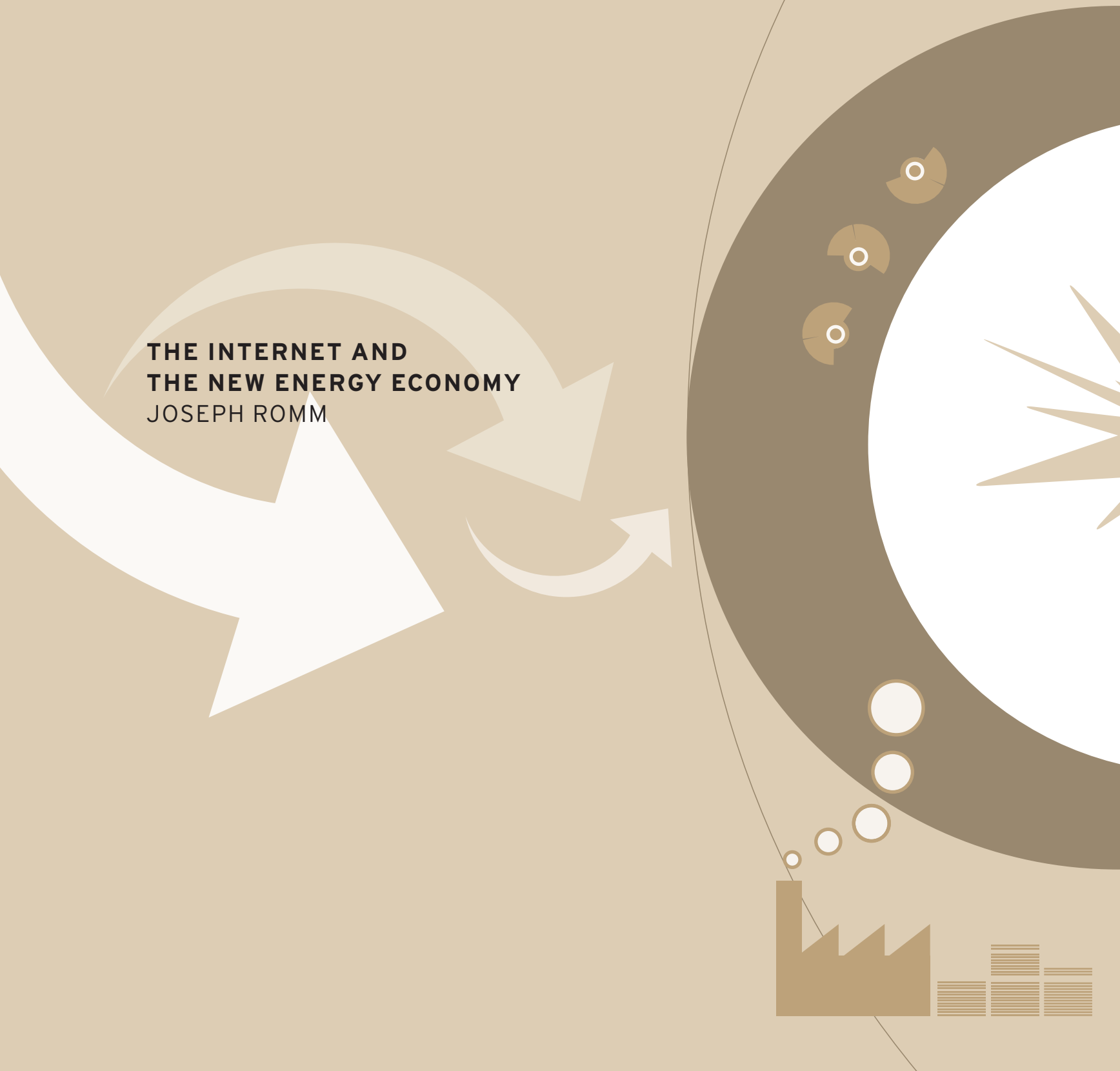
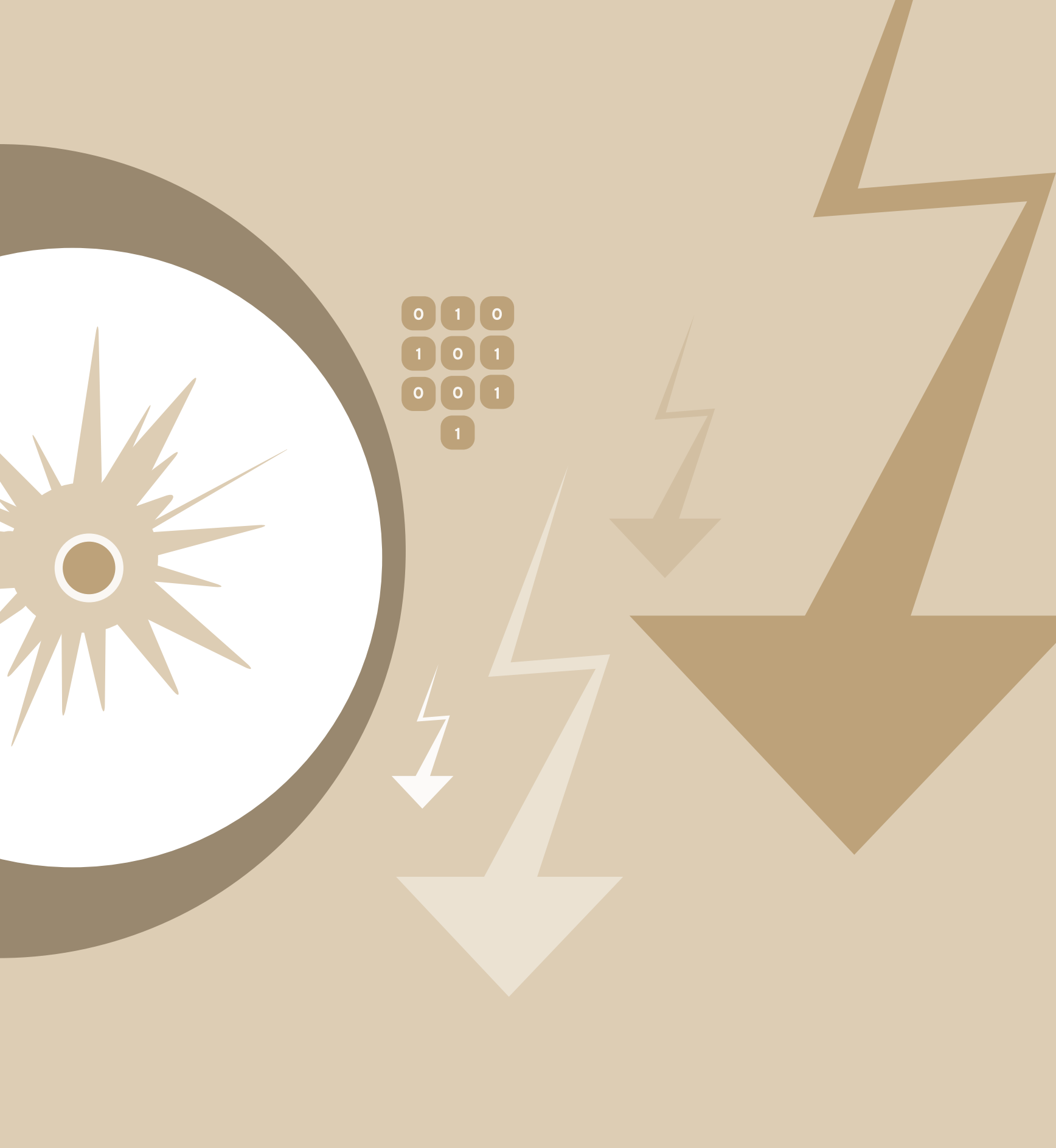
THE INTERNET AND THE NEW ENERGY ECONOMY

JOSEPH ROMM

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From 1996 through 1999, the U.S. experienced an unprecedented 3% annual reduction in energy intensity. This is more than three times the rate of the previous ten years and far higher than the rate projected by traditional energy forecasters. There is increasing data and analysis to support the view that there is a connection between the recent reductions in energy intensity and the astonishing growth in Information Technology (IT) and the Internet Economy.

EXECUTIVE SUMMARY

Growth in the Internet Economy can cut energy intensity in two ways. First, the IT sector is less energy – intensive than traditional manufacturing, so growth in this sector engenders less incremental energy consumption. Second, the Internet Economy appears to be increasing efficiency in every sector of the economy, which is the primary focus of this paper. The impact of the Internet economy on manufacturing, buildings, and transportation are all explored. The paper also considers the implications for growth in energy consumption and greenhouse gas emissions during the next ten years. This is a time when the Internet Economy is expected to grow rapidly and when the Internet is expected to be used to directly save energy through remote energy management of commercial and residential buildings.

Finally, there has been an argument put forward by two analysts, Mark Mills and Peter Huber, that the Internet is using a large and rapidly growing share of the nation's electricity, which in turn is supposedly driving an acceleration of overall U.S. electricity demand. Their numbers have very been widely quoted by financial analysts, major corporations, and the media. However, it is based on seriously faulty analysis and is inconsistent with recent national and state data, so all projections based on that analysis should be rejected.

TRENDS AFFECTING ENERGY INTENSITY

In the era of low-energy prices preceding the early 1970s, the energy efficiency of many household, transportation, and industrial technologies in United States improved little. As a result, energy demand and gross domestic product (GDP) in United States historically grew in lockstep: a 3% increase in GDP meant nearly a 3% increase in energy demand. The energy intensity of the economy (energy consumed per dollar GDP) declined only very slowly from 1950 to the early 1970s. There was a widespread view in the country that this linkage was unchangeable, that energy was essential for economic growth. There was little recognition that energy efficiency could break that trend without sacrificing economic growth.

The inextricable connection between energy and economic growth came to an abrupt end with the Arab oil embargo of 1973-1974. From 1973 to 1986, GDP grew 35% in real terms while the nation's consumption of primary energy remained frozen at about 74 quadrillion BTUs (or quads). One third of the dramatic shift in energy intensity during this period was due to structural changes, such as declining share of economic activity in energy – intensive

industries and increasing shares in the less energy – intensive service sector. Two thirds was due to increases in energy efficiency throughout the economy as a whole.

Following the crisis, Americans bought more fuel – efficient cars and appliances, insulated their homes, and adjusted thermostats. Businesses retrofitted their buildings with more efficient heating and cooling equipment and installed energy management systems. Factories adopted more efficient manufacturing processes and purchased more efficient motors. These investments in more efficient technologies were facilitated by higher energy prices, by government policies and programs, and behavioral changes resulting from concerns about availability of energy and dependence on Persian Gulf oil.

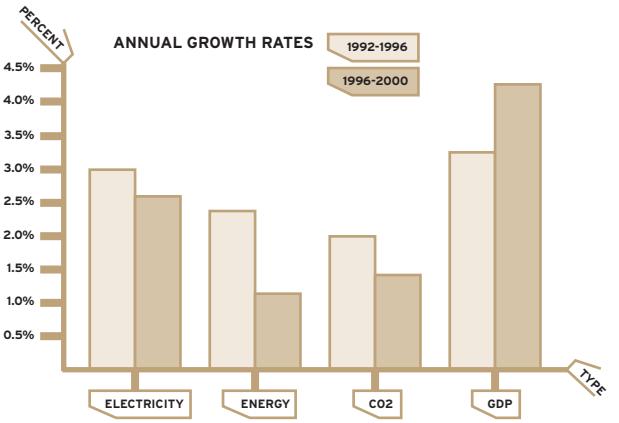
The nation's energy intensity routinely declined by 2% per year during the years from 1973 to 1986, and some years intensity even declined by over 3%. Starting in 1986, energy prices began a descent in real terms that has continued to the present, and government investments in energy R&D and deployment programs have declined. These trends have contributed to a growth in energy demand from 74 quads in 1986 to 94 quads in 1996. Because of the comparable growth in GDP over the same period, the energy intensity of the economy declined less than 1% per year over the ten-year period.

RECENT DROPS IN ENERGY INTENSITY

In the late 1990s, a startling shift appeared in the statistics. The nation's energy intensity dropped 3.7% in 1997 and 3.9% in 1998. It is unprecedented for the U.S. economy to see such improvements in energy intensity during a period of low energy prices and relatively low public awareness of energy issues. The nation had two years of economic growth totaling 9%, yet energy use in 1998 was hardly changed from its 1996 levels, just slightly more than 94 quads. In both 1999 and 2000, energy intensity dropped by 2%.

Looking at the recent data another way, if we consider what might be called the immediate pre-Internet era (1992-1996), GDP growth averaged 3.2% a year, while energy demand grew 2.4% a year. In the Internet era (1996-2000), GDP growth averaged over 4% a year, while energy demand grew only 1.2% a year, a 50% drop. This is a remarkable change – higher GDP growth and lower energy growth. From the point of view of greenhouse gases, the immediate pre-Internet era saw 2% annual rises in carbon dioxide emissions, while the Internet era has seen rises of 1.5%.

The recent remarkable declines in U.S. energy intensity motivated the Center for Energy and Climate Solutions (CECS) to think about what big changes might be happening in the U.S. economy that could be having such a big effect and whether those changes are likely to continue and possibly grow. The purpose here is not to explain in detail all of reasons for the sharp drop in energy intensity over the past two years. There is a great deal of year-to-year fluctuation in the change in energy intensity, which is due to a variety of factors. Weather, for instance, can play a big role. In 1998, the country experienced both a very warm winter (which reduces the consumption of natural gas and other heating fuels) and one of the hottest summers on record (which increases the consumption of electricity for air conditioning). The weather was responsible for perhaps 0.5% out of the 3.8% average annual drop in energy intensity in 1997 and 1998.



Other relevant factors include the rebound in federal investment in energy efficiency in the 1990s, though a countervailing trend has been the decline in demand-side management funding by utilities. Slowdown in the Asian economies also reduced exports (and hence U.S. manufacturing). Unfortunately, EIA requires a considerable amount of time to collect and analyze key data on energy consumption trends by sector (such as buildings and manufacturing), so it will be a few years before we have a detailed understanding of what is going on. Disentangling all of these factors is beyond the scope of this paper. The goal here is in examining some key trends that may well be having an impact today and are likely to play an important role in the next decade. The impact of Information Technology and the Internet economy is the key trend examined here.

THE NEW ENERGY ECONOMY: A FUNDAMENTAL CHANGE

In a 1999 report, CECS examined the relationship between the economic growth and a new trend in energy intensity, and concluded that the Internet economy could fundamentally and permanently alter the store relationship – allowing faster growth with less energy use than we have seen in the past. We labeled this a "New Energy Economy, " and predicted "annual improvements in energy intensity of 1.5%—and perhaps 2.0% or more." Although we were criticized by some, including EIA, for this prediction, the most recent data cited above are strongly suggestive that a fundamental change is occurring in the economy and that our scenario may well be a key part of the explanation. Even EIA is substantially increasing its projection for annual energy intensity gains this decade.

Our report "The Internet Economy and Global Warming: A Scenario of the Impact of E-commerce on Energy and the Environment," remains the most comprehensive analyses to date on the nature and scope of the Internet's effect on energy consumption and greenhouse gas emissions. It is available online at www.cool – companies.org.

Analysis by EPA and the Argonne National Laboratory suggests that one third to one half of the recent improvements in energy intensity are "structural." Structural gains occur when economic growth shifts to sectors of the economy that are not particularly energy intensive – such as the IT sector, including computer manufacturing and software – as opposed to more energy-intensive sectors, including chemicals, pulp and paper industry, and construction.

More importantly, the remaining one-half to two-thirds of the improvement in our economy's use of energy comes from overall efficiency throughout the system as a whole, occurring when businesses change their activities in ways that reduce energy use relative to their output of goods and services. For example, a factory might use more efficient motors on its assembly line or better lighting in its buildings, or a chemical manufacturer might redesign a process for making a chemical to cut the energy used per pound of product.

According to our findings, the Internet economy itself seems to be generating both structural and efficiency gains. If companies put their stores on the Internet, rather than constructing new retail buildings, which would represent an Internet structural, gain. If that same company used the Internet to more effectively manage its existing supply chain, it would be an efficiency gain. The following is a brief summary of our principal findings, with some relevant updated data and analysis. A longer discussion of each of these sectors – manufacturing, buildings, transportation – can be found in the original report.

INTERNET MAKES MANUFACTURING MORE EFFICIENT

The Internet Economy appears to be causing a broad improvement in manufacturing efficiency. Federal Reserve Board Chairman Alan Greenspan told Congress in June 1999 "Newer technologies and foreshortened lead-times have, thus, apparently made capital investment distinctly more profitable, enabling firms to substitute capital for labor and other inputs far more productively than they could have a decade or two ago."

As traditional manufacturing and commercial companies put their supply chain on the Internet, and reduce inventories, overproduction, unnecessary capital purchases, paper transactions, mistaken orders, and the like, they achieve greater output with less energy consumption.

Between 1990 and 1998, Dell computer grew considerably while simultaneously moving many of its operations to the Internet. Its sales increased 36-fold, but its physical assets (i.e. buildings, factories) rose by only a factor of four. IBM has used the Internet to improve communication between factories, marketing and purchasing departments. If one factory cannot meet its production schedule or if demand suddenly rises, IBM finds out in time to increase production at another factory. This has allowed the company to better utilize its existing manufacturing capacity and thus avoid making additional investments to meet increased volume requirements. By mid – 1998, the reduced investment and operating costs had saved the company $500 billion. Many, many companies from General Electric to Cisco Systems, are achieving similar efficiencies.

Inventories may be the single measure of the manufacturing sector's overall efficiency. Higher inventory turnover and lower overall inventories represent a vast savings for the economy: Less new manufacturing infrastructure is required needs to be constructed, fewer excess goods need to be manufactured and then shipped to warehouses – where they are heated and cooled--and then either shipped again for ultimate sale or, in many cases surplused. Every stage of this process consumes a vast quantity of energy, in buildings, transportation, and most especially in the manufacturing of basic materials (such as the steel in the excess manufacturing capacity) and the manufacturing of finished goods.

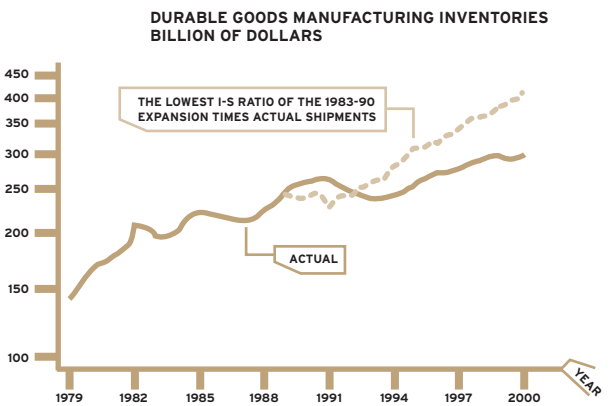
The Internet is widely viewed as likely to have a large impact on inventories. As the Department of Commerce put it in July 2000, "by improving communications with suppliers and customers, IT has facilitated manufacturers, efforts to limit their inventory exposure." Companies are increasingly using the internet to work together for better forecasting and restocking, using a process called Collaborative Planning Forecasting Replenishment (CPFR). Home Depot uses information technology and the Web throughout its supply chain to largely bypass the warehouse: 85% of its merchandise moves directly from the manufacturer to the storefront. The Automotive Industry Automation Group tested an internet – based supply chain management system that cut lead times 58%, a 24% improvement in inventory levels,

and a 75% reduction in error rates; a similar system by Toyota is cutting in-house inventories by 28% and storage requirements in the plant by 37%, freeing space for manufacturing.

What is potential impact on the digital economy on inventories? Ernst & Young has estimated that CPFR could lead to an inventory reduction of $250 billion to $350 billion across the economy, roughly a 25% to 35% cut in finished goods inventory across the supply chain.

What has been achieved to date in the economy? According to the Department of Commerce July report, with the aid of IT "durable goods manufacturers have reduce their inventory ratios from 16.3% of annual shipments in 1998," which was the lowest ratio in the 1983 to 1990 expansion, "to just 12.0% in the last 12 months." The implications are enormous: "If U.S. manufacturers of durable goods today held inventories at the 1988 inventory to sales ratio, they would be holding an additional $115 billion in inventory." This represents $115 billion in durable goods that were not manufactured, even as output and GDP soared. It means "companies are spared the expense of storing and securing one – third more inventories than they now hold" and "they avoid the inevitable losses from holding inventories for products that lose favor in the marketplace." This means saving the enormous energy required to make, move, and store $115 billion worth of goods.

Clearly, if we continued to have significant GDP growth without significant inventory growth, that would suggest that our energy intensity gains will continue. If indeed the Ernst & Young estimate is correct, then we have not even achieved half of the inventory savings that the Internet economy will ultimately make possible.



INTERNET SAVES COMMERCIAL BUILDING ENERGY

The Internet holds the potential to increase efficiency in a variety of buildings, including retail, warehouse and storage, and office buildings. Probably the best known and most widely studied consumer e – commerce activity is book purchasing, popularized first by Amazon.com. Consider these statistics from a 1998 case study on Amazon.com to which we have added two lines of energy calculations: So a plausible estimate for the ratio of commercial building energy consumption per book sold for traditional stores versus online stores is 16 to 1. So Internet energy efficiency appears to be a very powerful tool for reducing building energy intensity. The impact of e – commerce on transportation energy consumption is discussed later.

Table 1. Comparison of Operating Models of Land-based Versus Online Bookstore[11]

	Traditional Superstore	**Online Bookstore** (Amazon.com)
Titles per Store	175,000	2,500,000
Revenue per Operating Employee	$100,000	$300,000
Annual Inventory Turnover	2-3 times	40-60 times
Sales per square foot	$250	$2,000
Rent per sq. ft.	$20	$8
Energy costs per sq. ft.[12]	$1.10	$0.56
Energy costs per $100 of sales	$0.44	$0.03

This type of efficiency gain is likely to be seen throughout a wide swath of retail buildings, not just book stores, but electronics, software, pet stores, toy stores, banks, and the like. Mark Borsuk, Executive Director of the Real Estate Transformation Group, wrote recently that Wall Street will "demand that retailers curtail new store growth, reduce the number of locations, and shrink store size."

What is the ultimate impact in the retail sector likely to be? A 1999 OECD report on the impact of e – commerce estimated that "economy – wide efficiency gains" from a "business – to – consumer scenario" could "reduce total wholesale and retail trade activity for consumer expenditures by 25 percent":

It was assumed that this reduction would lead to a decline in the use (cost) of buildings and related services (construction, real estate, utilities) by 50 percent, or a 12.5 percent decline in total for retail and wholesale trade.

These savings, plus savings in labor and capital, "leads to a reduction in aggregate distribution cost of about" 5.2% and in "total economy – wide cost by about" 0.7%. The study notes that "While small, this is still a considerable gain, since a reduction in these costs is a rough proxy for productivity gains [total factor productivity]."

It is interesting that so much of the cost savings in this estimate are in the energy area: construction and utilities. So, if total economy-wide cost is reduced on the order of 0.7% from business-to-consumer e-commerce, then it seems plausible to estimate a concomitant reduction in energy costs of the same fraction. That would mean energy cost savings of $4 to $5 billion, most of which would be in the commercial buildings sector and industrial sector

(i.e. construction). A 12.5% decline in the use of retail buildings alone represents about 1.5 billion square feet of commercial building space no longer needed.

As for office space, the Internet has two key impacts. First, companies like IBM and AT&T are cutting office space for workers who spend a great deal of time with customers outside the office, such as sales and service. They give those "Internet telecommuters" laptops, put critical data on their corporate intranets, and then the workers spend their time working on the road and at home. If they need to come into work they can email in to reserve shared office or meeting space. Today, for example, virtually all of IBM's sales force – nearly 17% of their total workforce worldwide – can operate independent of a traditional workplace, helping cut occupancy cost per employee by one-third. With roughly the same number of total workers in 2002 as in 1998, AT&T expects to cut total square footage from about 32 million square feet to 21 million square feet. Each Internet telecommuter saves about 175 square feet per worker times 20 kWh per square foot or 3500 kWh a year. We would not be surprised if the incremental home electricity consumption were 500 kWh based on telecommuters spending about one third of their time at home. The net savings would be 3000 kWh a year, worth about $200 a year.

Second, the Internet is driving a boom in purely home-based work. International Data Corporation has estimated that the number of home offices is growing by about three million a year. IDC projects the number of home offices with PCs on the Internet will grow from 12 million in 1997 to 30 million in 2002 (IDC 1999). This increase in home offices reduces the amount of incremental office space required for an increment in GDP. We believe that translates into a net savings in building energy consumption. A worker in a traditional small office building (with an average 300 square feet of space) would probably be consuming upwards of 6000 kWh a year. Her incremental home-based electricity consumption is perhaps 1500 kWh, yielding a net savings of more than 4000 kWh (Romm 1999).

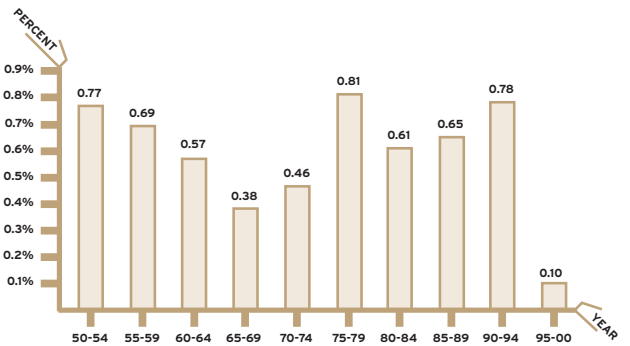
Suppose that from 1997 to 2007 the Internet leads to an additional one million home offices each year. Suppose that half of those are Internet telecommuters and half are Internet entrepreneurs and that they avoid on average 150 square feet and 300 square feet of office space respectively. That would avoid the need for more than 2 billion square feet of office space by 2007.

A very preliminary estimate of the potential net impact of the Internet on Buildings is that by 2007, business-to-consumer and business – to – business e-commerce together could avoid the need for 1.5 billion square feet of retail space – about 5 percent of the total – and up to 1 billion square feet of warehouses. Internet technology may also eliminate as much as 2 billion square feet of commercial office space, the equivalent of almost 450 Sears Towers, along with all the lighting, heating and cooling that goes with it.

Energy savings from operations and maintenance alone for these "unbuildings" total 53 billion kilowatt hours per year, about 13 percent of total electricity growth projected under old, business – as – usual scenarios. That equals the output of 21 average power plants, plus 67 billion cubic feet of natural gas. Expressed in terms of the global warming issue, this Internet "unbuilding" scenario would prevent the release of 35 million metric tons of greenhouse gases in the U.S.

Is there any evidence that we have entered a period in which we can have GDP growth without the need for as many new buildings, particular commercial office buildings? We believe so. Consider a recent analysis by James Paulsen, Chief Information Officer, of Wells Capital Management. According to this analysis, "during the 45 years after World War II until 1995, on average every 1 percent change in real GDP growth produced a 0.65 percent change in job growth." But in the last five years, the job impact of GDP growth has virtually stopped: "Since 1995, for every one percent rise in real GDP growth, job growth has increased by only 0.1 percent – the weakest job impact in the post-war period!"

This is strongly suggestive that we have entered a where GDP growth does not require as much commercial office buildings (and storage for inventories and retail stores) as has historically been the case. We have not yet seen data on whether there has been an accompanying reduction or slowdown in construction, which is a very cyclical industry and subject to significant lags between supply and demand.



Percent Change in Annual US Job Growth Due to A 1 Percent Change in Real GDP Growth By 20-Quarter Increments

INTERNET AND TRANSPORTATION

The potential energy impact of the Internet Economy on the transportation sector is more of a mixed bag, with factors at play that may offset one another – potentially increasing energy intensity in some areas, but cutting it in others. If certain trends persist, however, Internet technology could lead to dramatic drops in energy in energy intensity in this sector.

The Internet holds the prospect of increasing energy intensity by

- Increasing delivery of products by relatively inefficient means, including overnight delivery by air and/or truck
- Increased shipping in general, as the globalization fostered by the Internet makes it easier to purchase objects from very far away
- Increasing personal (and business) travel, as people seek to meet in person the widely dispersed people they have met on the Internet

On the other hand, the Internet holds the prospect of reducing transportation energy intensity by

- replacing some commuting with telecommuting
- replacing some shopping with teleshopping
- replacing some air travel with teleconferencing
- enabling digital transmission or e – materialization of a variety of goods that are today shipped by truck, train and plane, including formerly printed material, software, construction materials, and the like
- improving the efficiency of the supply chain
- increasing the capacity utilization of the entire transportation system.

This sector is particularly difficult to analyze. For instance, some of the above effects are interactive and potentially offsetting: some personal shopping by car is likely to be replaced by small-package shipping. A 20-mile round-trip to purchase two 5-pound products at one or more malls consumes about one gallon of gasoline. Having those packages transported 1000 miles by truck consumes some 0.1 gallons, and much less than that if railroads carry the packages for a significant fraction of the journey. Shipping the packages by air freight, however, consumes nearly 0.6 gallons. These numbers are only very rough approximations, but they make clear that the transportation energy benefits of teleshopping are only partially offset by overnight delivery of e – commerce purchases by air freight.

Even well studied areas, such as the impact of telecommuting on vehicle miles traveled (VMT), are exceedingly complicated. Further, it will be particularly difficult to disentangle trends that have been ongoing for many years – such as the rapid growth in international trade, air travel, and VMT – from any impact the Internet may have. The huge swings in

the price of oil will also make analysis difficult in the short term.

Nonetheless, a few key points deserve mention. First, HBB (home-based business) workers spend less time traveling in cars (for all purposes) per day than either home-based telecommuters (HBT) or non-home-based (NHB) workers (i.e. conventional workers), according to the "first known U.S. study of HBB travel." HBB spent 1.23 hours a day traveling in cars, whereas HBT spent 1.39 and NHB spent 1.61. So to the extent the Internet is leading to an increase in HBBs, it will slow VMT growth.

Second, as one major study of energy use and lifestyles noted, "a minute spent traveling uses 8 and 12 times as much energy, respectively, as a minute spent in service buildings or at home." Moreover, one's home is always using a fair amount of energy, even when one is traveling, whereas the family car uses energy only when it is being driven. Therefore, the incremental energy benefit of spending an extra minute online rather than traveling is even greater than 12 to 1. Some recent studies suggest that heavy Internet users (greater than five hours a week) spend less time driving than average.

Third, the Internet is helping make the freight industry much more efficient. For instance, as many as half the freight trucks on the road are empty at any one time. A number of companies are auctioning off that empty space online, such as The National Transportation Exchange (NTE). Although this area is poorly studied, it seems clear that the capacity utilization of the trucking system has begun to increase. One trucking company, Yellow Freight, has already reported productivity gains of 20% from the application of IT.

The great unknown question at this point is whether or not a significant fraction of Americans will change their driving habits over the next few years once it is possible to make a critical mass of cyber-trips on the Internet. That is, will the Internet be the mall of the 21st Century?

Already, in the last two and a half years, the growth rate in vehicles miles traveled (VMT) has slowed, and the VMT to GDP ratio has dropped dramatically. In November 1999, EIA wrote of the "continued weakening of the relationship between income and travel growth." Preliminary reports from the State Highway Agencies reveal that total VMT rose only 2% in 1999, the slowest growth since 1991, a recession year, and that VMT has risen only 1.6% for the first half of 2000.

We suspect the Internet economy will be no worse than neutral in the transportation sector, but could well have a positive impact, especially if teleconferencing becomes much more popular. We may be seeing early signs of

that, but it is certainly too early to tell. The impact in the buildings sector, and especially the manufacturing sector, seem likely to be beneficial. Therefore, we believe the overall impact of the Internet economy is to reduce the nation's energy intensity, perhaps significantly.

WHAT ABOUT ENERGY USE BY THE INTERNET?

As to the important question of whether the Internet itself is consuming vast amounts of electricity, the facts simply – and irrefutably – fail to support such a conclusion. To begin with, the rate at which U.S. electricity demand is growing has slowed since the start of the Internet boom. As then EIA head Jay Hakes testified in February 2000:

"From 1985 to 1995, retail electricity sales grew at a rate of 2.6% per year.... Since 1995, the use of the Internet has increased dramatically, yet retail electricity sales have grown by 2.1% per year."

The immediate pre-internet era (1992-1996) saw electricity demand rise 2.9% per year. Since 1996, electricity demand has risen only 2.3% per year. And this has all occurred in spite of higher GDP growth since 1995, hotter summers (1998 was the hottest summer in four decades in terms of cooling-degree days; 1999 was the second hottest summer), and less support by utilities for demand – side management, all of which would normally lead to higher growth in electricity demand. This likely has much to do with the trends already discussed here.

It is worth examining this question in more detail because the statistics and projections presented by Peter Huber and Mark Mills have been repeated widely by financial firms, energy corporations, the news media, and policy-making circles. For instance, the president of Duke Energy's Power Services is quoted in the October 2, 2000 issue of the Industry Standard that "electrical demand has been outpacing GDP growth. And we believe the main reason is the Internet an electronic commerce."

Mills and Huber argue the Internet has become a major energy consumer because it supposedly requires a great deal of electricity to run the computers and other hardware powering the Internet economy. In fact, according to recent research, they appear to have significantly overestimated the energy consumption of most critical pieces of equipment.

Scientists at Lawrence Berkeley National Laboratory (LBNL) examined in detail the numbers underlying the Mills and Huber analysis, and found that the estimates of the electricity used by the Internet were high by a factor of

eight. Major overestimates were found in every category, including their calculations of energy used by major dot – com companies, by the nation's web servers, by telephone central offices, by Internet routers and local networks, and by business and home PCs.

The Internet does not consume 8% of U.S. electricity as Mills claims. The Koomey et al. analysis showed that this estimate is too large by a factor of eight. Computers, office equipment, and the like do not consume 13% of electricity, as Mills claim; a better number is 3%.

Mills and Huber assumed, for instance, that a "typical computer and its peripherals require about 1,000 watts of power." In fact, the average PC and monitor use about 150 watts of power; this dips to 50 watts or less in energy-saving mode. Laptop computers, a key growth segment, are particularly low energy users, with some using under 30 watts. Moreover, computers are getting more energy – efficient every year because of steady improvements in technology driven in part by the growing market for portable equipment (and by the IT sector's desire to reduce its environmental impact). New flat screens typically use about a quarter of the energy of traditional video display terminals with cathode ray tubes.

These basic mistakes are reflected in their conclusions. Mills and Huber claim that from 1996 to 1997, the increase in electricity consumed by all computers used for the Internet constituted more than 1.5% of all U.S. electricity consumed that year. Yet total electricity consumption for all purposes grew slightly less than 1.4% during that period, which would imply that electricity growth for everything else equaled zero – despite economic growth of 4.5%. While we believe that the Internet reduces energy intensity, we don't believe it has quite that dramatic an effect.

But mathematical and data errors are only part of the problem. Indeed, it appears Mills and Huber have the entire Internet energy story almost completely backwards. One of the reasons why energy intensity declined so slowly from 1987 through 1996 is likely that businesses in particular purchased a great many computers and other IT equipment that consume electricity, yet generated little accompanying productivity gains to offset that increased energy use. But Internet changed all that, unleashing a storm of new productivity in every sector of the economy. By then, of course, most office desks already had computer. The added energy needed to shift PCs from traditional uses to the Internet is modest compared to its overall benefit.

Computers and the Internet may well lead to more home electricity consump-

tion. This is part of a long – standing trend, as homes have for some time been getting bigger and more stocked with electronic equipment. But the question is, if people spend more time on the Internet, what are they spending less time doing? Some will be watching television less; others reading newspapers less; some may be printing individual items of interest to them rather than receiving entire printed catalogs or directories in the mail; others will be working at home rather than in an office building; and, potentially, some may be not be driving to work or to malls as often as before. These are all activities that would normally consume a great deal of energy and their potential displacement by home Internet use is the subject of recent analysis, which suggests that some substitution is already occurring.

DIRECT ENERGY SAVINGS BY THE INTERNET

So far this paper has focused on the potential "indirect" energy efficiency benefits of the Internet. Yet in the very near future the Internet will itself be used to save energy directly as commercial and residential buildings have their energy managed over the Internet.

Digital energy management control systems (EMCS) can continuously gather data about what is taking place in a building and how its equipment is operating, feeding it into a central computer used to control building systems and optimize energy performance. Energy experts at Texas A&M have shown in two dozen Texas buildings that using such an approach can cut energy use 25 percent with an 18-month payback in buildings that have already received on upgrade with the latest energy-saving equipment.

Increasingly, such technologies will operate over the Internet itself. Companies like SiliconEnergy have developed software that uses the Internet for real-time data collection and analysis and. energy management. We believe energy outsourcers like Enron (discussed below) may ultimately manage hundreds if not thousands of buildings over the Internet.

The state of California is examining whether "demand – responsive" buildings may be a more cost – effective and environmentally superior strategy for dealing with peak power demand than building new generation. Currently, on hot days, California sees peak demand of 45,000 MW, of which 13,000 MW goes to air conditioning and 5,000 MW goes to commercial lighting. If a building has an energy management control system, then it could receive real-time pricing information over the Internet. On a voluntary basis and in return for a rebate from the utility, buildings could allow the indoor temperature to drift up

1 to 2 degrees Fahrenheit. This would not affect comfort much, especially since on days of predicted heat waves, the owner could precool the building. Similarly, hot days typically occur when the sun is out, so a "demand-responsive building" could also initiate some reduced lighting, both interior and exterior. This strategy could shave some 1000 MW from California's peak demand without building several new power plants. California will be launching a pilot program soon, and, if it is successful, introduce the program statewide.

Many utilities have begun exploring Internet-based home energy management systems, which would give individual homeowners more control and feedback over their home energy use, or the ability to have an outside energy company or expert software system optimize their energy consumption. Early trials of remote controlled home energy management systems suggest the savings in energy bills could be as high as 10%.

OTHER KEY TRENDS AFFECTING U.S. ENERGY CONSUMPTION

This paper has focused on the impact of the Internet on U.S. energy consumption. There is one other trend that is likely to have a significant impact this decade, and it deserves mention.

Corporate GHG Commitments: There is another recent business trend that will have lasting impact on energy consumption trends. Increasingly, major corporations are making company-wide commitments to reduce their greenhouse gas emissions. As the Wall Street Journal noted in an October 1999, article:

In major corners of corporate America, it's suddenly becoming cool to fight global warming.

Facing significant shifts in the politics and science of global warming, some of the nation's biggest companies are starting to count greenhouse gases and change business practices to achieve real cuts in emissions. Many of them are finding the exercise is green in more ways than one: Reducing global warming can lead to energy-cost savings.

In 1999, Kodak announced in 1999 that they would reduce their greenhouse gas emissions 20% by 2004. DuPont – one of the biggest energy users in the United States – pledged publicly to reduce greenhouse gas emissions 65% compared to 1990 levels by 2010. Two thirds of those savings will come from reducing process-related greenhouse gases; the rest will come from energy. They pledged to keep energy consumption flat from 1999 to 2010 even as the company grows, and to purchase 10% renewable energy in 2010.

2001, Johnson & Johnson and IBM each joined the Climate Savers partnership with the World Wildlife Fund (WWF) and Center for Energy a Climate Solutions, pledging to make substantial energy and greenhouse emissions cuts. IBM, having already achieved an estimated 20% reduction in global CO2 emissions through energy conservation efforts from 1990 through 1997, is now pledging to achieve average annual CO2 emissions reductions equivalent to 4% of the emissions associated with the company's annual energy use through 2004 from a baseline of 1998. Even major oil companies including BP and Shell have committed to make major emissions cuts, at least some of which will come from efficiency investments in their own facilities.

THE FUTURE

In the September 7, 2000 issue of the Wall Street Journal, Huber and Mills discuss their theory that the Internet is an electricity hog, claim that "power demands are now growing at twice the rates planned for just a few years ago," and write about "the 3%-4% annual increases in power demand that now lie ahead."

As we have seen, there is no data to support these claims or projections. Quite the reverse. Since 1996, the country has had the fastest decline in its electricity intensity (amount of electricity needed to produce a dollar GDP) in decades.

What of the future? As noted, the growth rate of U.S. electricity consumption has been decelerating even in the face of much higher GDP growth. The Internet does not consume a large fraction of U.S. electricity today, nor do PCs, office equipment, and network equipment. The growth rate of power used by the Internet is much slower than the growth rate of the Internet. The Internet appears to save electricity indirectly (by making the whole economy more efficient) and, in the near future, will do so directly (through improved building energy management). The impact of energy outsourcing could be very significant on investment in energy efficiency. Finally, while the Internet economy certainly allows higher GDP growth, it seems unlikely that GDP growth in this decade will see an average growth rate equal to that of the past four years.

For all these reasons, it seems unlikely that the average annual growth rate of U.S. electricity demand in this decade will significantly exceed the 2.2% growth rate we have experienced since 1996.

Primary energy demand may be even more important than electricity demand growth, since it determines carbon dioxide emissions. If indeed the Internet is already reducing energy intensity, then it is likely to have a bigger

impact in the years to come. The Internet economy in the United States is projected to grow more than ten-fold – from its current level of tens of billions of today to more than $1 trillion in a few years. Moreover, while the Internet economy remains a small share of the total U.S. economy, it represents a much higher fraction of the growth in the economy.

The combination of trends described above makes it likely that this decade will not see the same low – level of energy intensity gains that the 1987 to 1996 period saw, which were under 1% per year. Annual reductions of U.S. energy intensity in the Internet era could well average 2.0%. If this comes to pass, most major economic models used in the country will need to be modified. It may be that many factors widely used in economic, energy, and environmental models – such as energy per GDP and inventories per GDP – need to be changed.

The Environmental Protection Agency did a preliminary analysis of potential impact of structural and economic changes driven by rapid growth in the IT – producing industries. The results suggest that mainstream forecasts, such as those by EIA, may be overestimating U.S. energy use in the year 2010 by as much as 5 quadrillion BTUs, wrongly inflating carbon dioxide emissions by up to 300 million metric tons. This equals about 5% of the nation's projected energy use and GHG emissions.

CONCLUSION

Contrary to a very popular myth fostered by the work of Mark Mills and Peter Huber, the Internet is not driving an acceleration of electricity demand. It appears instead to be driving efficiencies throughout the economy that have resulted in the biggest dropped into electricity intensity and energy intensity the nation has seen in decades.

The Internet economy appears to allow a very different type of economic growth than we have seen in the past, growth that does not require as much energy consumption as traditional economic growth. In other words, if there is a so-called “New Economy,” as many now believe, there is also a “New Energy Economy,” with profound impacts on energy, environmental, and economic forecasting. Other key trends, particularly energy outsourcing and corporate action on climate change, are likely to accelerate improvements in the nation’s energy efficiency. It therefore seems likely that 1996 to 2010 will not only see higher GDP growth than was seen from 1986 to 1996, but also lower energy and greenhouse gas growth. ■

FOOTNOTES

1 This historical discussion is based on Brown, Levine, Romm, Rosenfeld, and Koomey, "Engineering-Economic Studies of Energy Technologies to Reduce Greenhouse Gas Emissions: Opportunities and Challenges," Annual Raeview of Energy and Environment, 1998, pp. 287-385.

2 Skip Laitner, "The Information and Communication Technology Revolution: Can it be Good for Both the Economy and the Climate?" U.S. Environmental Protection Agency. Washington, DC. December 1999.

3 Laitner, 1999, op. cit.

4 G. Boyd and S. Laitner, Recent Tends in U.S. Energy Intensity, U.S. EPA, Washington D.C., 2000.in

5 Alan Greenspan, "High-tech industry in the U.S. economy," Testimony Before the Joint Economic Committee, U.S. Congress, June 14, 1999.

6 James Fallows, "The McCain Factor," The Industry Standard, February 21, 2000.

7 Lynn Margherio et al, "The Emerging Digital Economy," Department of Commerce, April 1998.

8 The energy used to create and transport the raw materials that a company uses may vastly exceed energy they use directly. For instance, Interface Flooring Systems calculates this "embodied energy" in raw materials for its carpet tile outstrips the energy needed to manufacture it by a factor of 12. That means a 4% cut in wasted product could save the equivalent of fully half the energy used in manufacturing.

9 Economics and Statistics Administration, Digital Economy 2000, Department of Commerce, Washington, DC, June 2000.

10 Andrew Wyckoff and Alessandra Colecchia, The Economic and Social Impact of Electronic Commerce, Organisation for Economic Co-Operation and Development (OECD), Paris, France, 1999. [Hereafter OECD 1999.]

11 The non-energy parts of this table are from Mohan Sawhney and David Contreras, "Amazon.com—Winning the Online Book Wars," case study, J.L. Kellogg Graduate School of Management, Northwestern University, p. 26, http://sawhney.kellogg.nwu.edu/. The case study cites Morgan Stanley Research as the source of the data in the table.

12 The energy costs are for retail stores and warehouses, respectively. EIA, A Look at Commercial Buildings in 1995, DOE, Washington, DC, October 1998. [Hereafter EIA 1998.]

13 Mark Borsuk, "Under the Knife." The Industry Standard. January 14, 2000.

14 Hereafter OECD 1999.

15 This assumes that retail space is approximated by using the figures for total mercantile and service floorspace, which was 12.7 billion square feet in 1995. EIA 1998. As for warehousing, even accounting for the increase in warehouses by internet retailers, the net result might be to eliminate the need for another one billion square feet of commercial warehouses and on-site storage at manufacturing facilities. Net energy savings from changes in warehousing may be modest, however, since new warehouses consume far more energy than the average warehouse.

16 Mahlon Apgar IV, "The Alternative Workplace: Changing Where and How People Work," Harvard Business Review, May-June 1998, pp. 121-136.

17 Avoided construction of all those buildings saves the equivalent of 10 power plants worth of energy, and another 40 million metric tons of greenhouse pollution. By 2010, e-materialization of paper, construction, and other activities could reduce U.S. industrial energy and GHG emissions by more than 1.5%.

18 James Paulsen, "Economic and Market Perspective," September 2000, Wells Capital Management.

19 Stacy Davis and Sonja Strang, Transportation Energy Data Book: Edition 13, Office of Transportation Technologies, U.S. Department of Energy, ORNL-6743, March 1993, p. 3.

20 Patricia Mokhtarian and Dennis Henderson, "Analyzing the Travel Behavior of Home-based Workers in the 1991 CALTRANS Statewide Travel Survey," Journal of Transportation and Statistics, Vol. 1 No. 3, October 1998, pp. 25-41. As the authors explain, estimates for the precise number of home-based workers vary widely, in part because of different definitions used by different analysts and in part because of difficulties in measuring who is actually working at home (and the related question of how much one has to work at home to qualify as a home-based business).

21 Lee Schipper et al, "Linking Life-Styles and Energy Use: A Matter of Time?" Annual Review of Energy 1989, 14:273-320.

22 N. Nie. and L. Erbring, L. "Internet and Society, " Stanford Institute for the Quantitative Study of Society, Stanford, CA: 2000.

23 EIA, -Short-Term Energy Outlook November, DOE, Washington, DC, December 1999.

24 Federal Highway Administration, "Traffic Volume Trends, May 2000," Department of Transportation, Washington, DC, September 2000.

25 EIA, "Statement of Jay Hakes before the Subcommittee On National Economic Growth," U.S. House of Representatives, Committee On Government Reform, Washington, DC, February 2, 2000.

26 Peter Huber and Mark Mills, "Dig more coal—the PCs are coming," Forbes, May 31, 1999, pp. 70-72.

27 Jonathan Koomey, Kaoru Kawamoto, Maryann Piette, Richard Brown, and Bruce Nordman. "Initial comments on The Internet Begins with Coal," memo to Skip Laitner (EPA), Lawrence Berkeley National Laboratory, Berkeley, CA, December 1999, available at http://enduse.lbl.gov/Projects/infotech.html. The underlying analysis is Mark Mills, The Internet Begins with Coal: A Preliminary Exploration of the Impact of the Internet on Electricity Consumption, The Greening Earth Society, Arlington, VA, May 1999.

28 Typical home Internet users are online 5 to 10 hours a week (under 500 hours a year). So they consume under 100 kWh a year on the Internet, more than a factor of 10 less than the estimate of the Forbes' authors of 1000 kWh a year. And this does not even include any of the myriad potential offsets, such as a reduction in television watching, which would save a considerable amount of electricity. Long before the Internet was popular, PCs have been used at home for word processing, games, and the like. It is therefore methodologically flawed to ascribe all or even most of the electricity consumed for home PCs in general to the Internet (for a discussion of this "boundary" issue, see Koomey et al, "Initial comments on The Internet Begins with Coal"). Internet telecommuters and home-based businesses use the Internet considerably more than the average home user, but, as discussed in our analysis, they are probably displacing far more electricity consumption by not working in an electricity-intensive office building.

29 N. Nie. and L. Erbring, L. "Internet and Society, " Stanford Institute for the Quantitative Study of Society, Stanford, CA: 2000.

30 Joseph Romm, Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions (Washington DC: Island Press, 1999), pp. 28-30, 57-63, 77-99, 140-156.

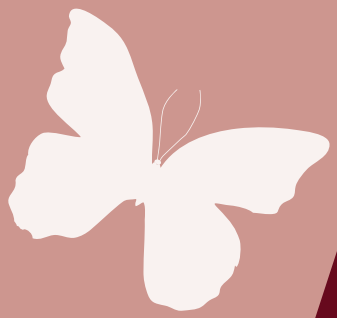
31 Personal communications with Arthur Rosenfeld, California Energy Commission, September 2000.

32 See, for instance, Romm, Cool Companies, pp. 117-118 and 159-162.

33 Steve Liesman, "Dropping the Fight On Science, Companies Are Scrambling to Look a Little Greener," Wall Street Journal, October 19, 1999, p. B1.

34 Peter Huber and Mark Mills, "Got a Computer? More Power to You," Wall Street Journal, September. 7, 2000, p. A 26.


BEST BEFORE 001.000.11.011



THE INTERNET AS CONSERVATION ACTIVIST

JAMES N. LEVITT

In the past, major technological advances have served as context for landmark conservation innovations. Our own era may also provide fertile context for innovation.

Picture this happy, little, domestic scene. It's 2050, and a young boy sits at the kitchen table watching his grandmother make breakfast. The boy springs a question. "Grandma, Daddy told me that you can remember back to when people didn't have the Web at home. Is that true? What was it like before you could use interactive holographs to videoconference with Aunt Jenny in Madagascar?"*

His Grandmother replies with a smile, remembering that she had asked her own Grandmother what the world had been like before television. "Oh, yes, Charlie, it is true. I do remember the world when all we had for telecommunications were old-fashioned voice telephones. Life was slower paced then, I guess."

From our vantage point in the year 2002, it is not possible to precisely predict just how different Charlie's world will be in 50 years. We can, however, project several general trends in North America and the world with reasonable certainty. For example, given what we know about the likelihood of natural population increases and immigration, it is quite probable that fifty years from now there will be more Americans – and more members of the world's human community – than there are today. The United States Census Bureau midrange projection is that the US population will grow from about 275 million people to around 400 million people in the next five decades.

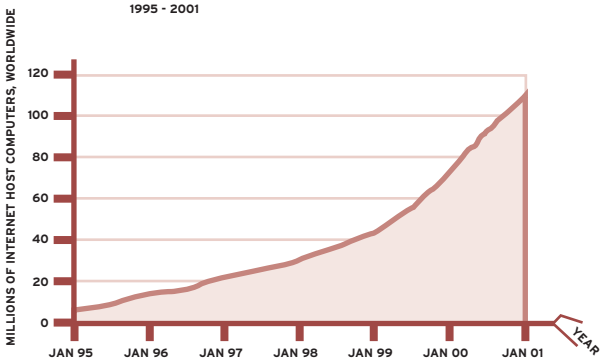
We can also project with some confidence that communications networks, including the Internet, will become cheaper, faster and more pervasive. Logistics networks that move people and things around are likely to become more efficient as well. Technologies that are being tested by commercial labs around the world continue to astonish us with their capability. For example, the latest optical technology in development can reportedly enable a single strand of fiber, thinner than a human hair, to carry every phone call, e-mail and Web page used by every person on earth.[1] And a variety of wired and wireless technologies are continuously extending the reach of the Internet.

We appear to be headed for virtually global high speed Internet access – at least for those who can afford it. Teledesic, a company launched by telecommunications visionary Craig McCaw, with a list of investors that includes Bill Gates, Motorola and the Boeing Corporation, claims that in 2005, when its service is targeted to begin, its multi-satellite "Internet-in-the-Sky" will be able to provide high speed online access to 95 percent of the earth's landmass, an area populated by more than 99% of humankind.[2]

Accordingly, we have recently seen, and despite recent stock market downturns should continue to see, rapid growth in the size of the network itself, in

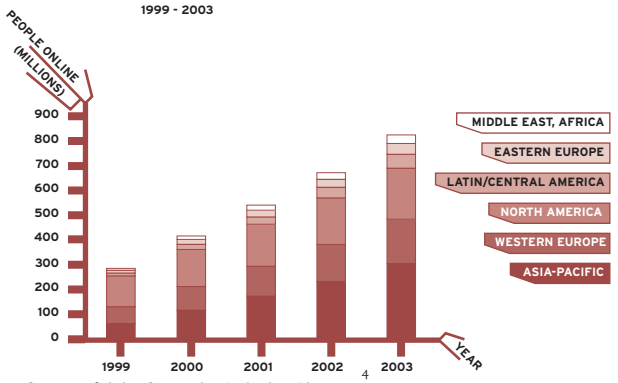
* This article first appeared in Sanctuary, the Journal of the Massachusetts Audubon Society, January/February 2001 (Volume 40, Number 3). It is republished here, in a revised form, with the permission of Sanctuary.

EXHIBIT 1: GROWTH OF THE INTERNET HOST COMPUTERS
1995 - 2001



Source of data: Internet Software Consortium[3]

EXHIBIT 2: PROJECTED GLOBAL INTERNET USAGE
1999 - 2003



Source of data: Computer Industry Almanac[4]

the size and scope of the global online population, and in the volume of commerce being conducted over the Internet. For example, the number of host computers that are connected to the Internet has soared from less than 6 million hosts in January 1995 to more than 109 million hosts in January 2001.

The population of individuals that is online is both expanding and becoming more international. As shown in Exhibit 2, below, the total world online population is expected to double between 2000 and 2003, from about 413 million to 825 million individuals, respectively. Over the same period, North American share of that total is expected to decline from 36% to 25%, and Asian/Pacific share is projected to grow from 28% to 37%; the rest of the world will also participate in the shift in world share of total Internet users away from North America.

Commerce over the Internet, driven principally by business-to-business transactions, is expected to grow at an even faster pace than the online population during the 2000-2003 period. Forrester Research, Inc. forecasts that worldwide e-commerce should grow more than fivefold in the space of 3 years, from less than $700 billion (in US dollars) in 2000 to more than $3.9 trillion in 2003.[5]

What we cannot predict with such confidence are the consequences that such networks will have for society or for the natural environment. At present, most observers around the world are focusing on the enormous technical and economic consequences that the new networks appear to be having. In our attention to the networks' amazing capabilities and the volatility of technology company stock prices, we appear to have largely overlooked – or made simplistically optimistic assumptions – regarding the potential impacts of these new networks on demographics, land use and the natural environment. This tendency happens to be very much in line with historic precedent.

For example, when the United States Senate Public Works Committee in 1954 held hearings on the Eisenhower Administration's bold proposal to build an Interstate highway system that would allow you to drive from Boston to Seattle without hitting a stoplight, a stream of testimony was heard about costs, economic benefits, where the roads would be built, and who would build them. The benefits expected from the new transportation network, from strengthening national defense to enhancing the quality of farm life, were myriad. However, there was virtually no testimony about the environmental impact that such a network might have.

While Forest Service officials spoke approvingly about the improved access that the new roads would give to Americans seeking outdoor recreational

opportunities, there was no comment regarding potential landscape fragmentation or habitat degradation. Global warming wasn't even on the policy radar screen. The single indication of any concern regarding the environment was in a letter in the back of the hearing book from an Association of Townships in Pensylvania who pledged to support the local "Don't be a litterbug" campaign.

It was not until the next year that Howard Zahniser of the Wilderness Society warned a House committee of the threat that Interstates could pose to remaining parcels of wildlands. Zahniser's testimony was an early indication of what was to become deep public concern over the complex set of environmental impacts associated with the new highways, ranging from air pollution to suburban sprawl.

Now, in the Internet age, we are prone to a similar sort of limited peripheral vision. It has been common in recent years for prognosticators, policy makers and employers to argue that the Internet and its relatives, by enabling increased telecommuting[6] and the streamlining of everyday life, is likely to alleviate a variety of ills, from traffic congestion to natural resource consumption constraints.

Early empirical evidence on the subject appears not to substantiate many of these hopes. Take, for instance, the dream of the paperless office that was predicted by sources ranging from BusinessWeek to Alvin Toffler in the 1970s and 1980s.[7] Ask yourself: Don't the offices of busy people still show evidence of a continuous flow of printed documents? While paper is being used for somewhat different purposes today than it was 20 years ago, the average tonnage of paper used continues to rise,[8] even now that some 50 percent of US households and most offices are connected to the Internet.

Similarly, while telecommuting continues to be promoted by organizations ranging from the US General Accounting Office to AT&T, in part because it purportedly will lead to reduced fuel consumption, air pollution and traffic congestion, there is scant evidence that if more people work from their homes, Americans on average will drive fewer miles. To the contrary, there is a very strong correlation, going back many decades, between the use of communications and transportation networks. Rather than substituting for travel, more intense use of communications networks may on balance prove to stimulate travel. Again, ask yourself: As the Internet has swept into the homes, schools and offices of your region, has traffic congestion subsided?

What we can learn from examining the history of communications and transportation networks in America, going back to the time of Thomas Jefferson, is that newly introduced networks tend to have both constructive and dis-

ruptive impacts, often quite different than those promoted in a given network's early days. New transportation and communications systems in North America have repeatedly enabled broad demographic shifts and changes in land use patterns, and have often been associated with dramatic environmental disruptions. The good news for conservationists is that, in the context of such network-related changes, landmark conservation initiatives have been successfully launched, typically with the involvement of key network entrepreneurs.

In the 1860s and 1870s, for example, transcontinental telegraphs and railroads bound the Union together from coast to coast, enabled the growth of settlements and markets along their way, and were closely associated with enormous environmental disruptions, including the extirpation of bison herds from most of the Great Plains. In the context of such dramatic upheaval, a railroad entrepreneur named Jay Cooke, who was striving to complete the financing of the Northern Pacific Railway, underwrote the art of Thomas Moran in order to dramatize the landscape around Yellowstone. Subsequent lobbying efforts, also supported by Cooke, led in 1872 to the creation of the world's first national park at Yellowstone. By helping to bring the national park idea to life, Cooke and his associate Frederick Billings were instrumental in bringing to the world one of America's great cultural inventions.

In the early 1900s, metropolitan electricity distribution networks and telephone systems were key enablers of the growth of great American urban centers, including New York, Chicago and San Francisco. By facilitating the widespread use of electric elevators, subways and trolleys, as well as convenient cross-town communications, these new networks were hailed as epoch-defining technical achievements. But the new networks, in combination with the railroads, mineral mines and coal mines, consumed vast quantities of wood in the form of distribution poles, cross-ties and mining timbers, thereby contributing to the precipitous decline in the health of North American forests.

Two sons of wealthy New York merchants, Theodore Roosevelt and Gifford Pinchot, enlisted the help of the era's captains of industry, including Andrew Carnegie, to create a truly national system of forest reserves, as well as a vast network of water resources that would be used for irrigation and hydroelectric development. Pinchot forcefully made the case that these resources were the ones on which Americans had built their civilization, and that the continued availability of the resources was critical to the national interest and ongoing prosperity.

In the 1950s, 1960s and 1970s, the emerging networks were interstate highways, passenger air transportation routes and broadcast networks. These

networks were instrumental enablers of the post-war shift of America's population and housing construction activity from urban centers to suburban settlements. In addition to burgeoning suburbanization, the era is well remembered for its environmental problems: Los Angeles smog, fire on Cleveland's Cuyahoga River, and a dramatic DDT-related decline in the health of bald eagles, ospreys and other birds.

Once again, however, network proliferation, demographic change and widely noted environmental disruptions provided a fertile context for bi-partisan, multi-sectoral land and biodiversity conservation initiatives, including the establishment of the Land and Water Conservation Fund, the passage of the Wilderness Act, the inventive use of tax incentives to encourage conservation easements, and the passage of the Alaska National Interest Lands Act, among many others. As in earlier eras, network entrepreneurs emerged as key players in the conservation initiatives. For example, Laurence Rockefeller, grandson of John D. Rockefeller and himself a notably successful venture capitalist, investor in the passenger air transportation sector and eco-tourism entrepreneur, chaired the Outdoor Recreation Resources Review Commission (the ORRRC) that served Presidents Eisenhower, Kennedy and Johnson. It was Rockefeller and the ORRRC that championed the idea of a Land and Water Conservation Fund to be financed by revenues from the Highway Trust Fund, and subsequently, from federal offshore oil lease revenues. In a similar vein, R.O. Anderson, at the time one of the largest private landowners in the United States and Chairman of the Atlantic Richfield Company, was a major backer of the effort to build an oil pipeline from the North Slope to Valdez, Alaska. Anderson was also a key player in the global environmental protection movement, and the deal that lead to the passage of the Alaska Lands Act.

Today, as the Internet has become a widespread, mass market phenomenon, there are indications that demographic and land use patterns are again shifting. For example, during the 1990s there was a net positive migration of Americans from metro areas to more rural counties, reversing for only the second time in more than a century the great migration from farms to cities. And the annual rate of conversion of open space to developed land has accelerated, both locally and nationally. Massachusetts Audubon's recently revised report, Losing Ground, documents these land use trends and the associated potential for landscape fragmentation and wildlife habitat disruption in Massachusetts.

What role might the Internet and advanced logistics systems play in these changes? First, early empirical data and a multitude of anecdotal evidence sug-

gest that the Internet can act as a direct enabler of suburban and rural deconcentration (popularly known as sprawl). It allows people to "live where they like" and pursue their livelihoods and maintain social connections over the network. Second, in an indirect fashion, the "new economy" has generated substantial new wealth in recent years, supporting the market for far-flung travel and the development of second-home "ranchette" communities. And third, new communications and transportation networks are present as coincidental amenities that enhance the mobility of an aging baby-boom population that is inevitably preparing for retirement in a wide variety of urban, suburban and rural settings.

But, as in earlier eras, these changes also offer some reasons for hope. Impressively powerful tools are being developed to bring big advances to the practice of conservation science, conservation education, advocacy, resource management and organizational development. Network entrepreneurs, ranging from Gordon Moore and Ted Turner to Craig McCaw, are generously supporting land and habitat conservation efforts. And with the concerted effort of public, private, non-profit and research/academic sectors, landmark conservation initiatives are, for the first time in several decades, finding broad bipartisan support in the US. For example, in 2000, during the same year that the Pingree project in Maine – the largest private conservation easement deal in American history – was consummated, the US Congress funded the restoration of the Everglades – a project that may prove to be the largest civil engineering effort ever conceived. And, in Massachusetts, the Community Preservation Act, which allows towns to raise revenues for local conservation efforts, finally passed after 15 years of effort.

Across the globe, there is need for a fresh understanding that so-called "non-point source" threats to habitat and our irreplaceable natural heritage are related to growing, increasingly affluent populations AND to proliferation of networks that are evolving from "anytime/anywhere" to "all the time/everywhere." We need new strategies that: align local, regional, national and international conservation efforts in a globalized world; that use the new communications and transportation networks themselves to monitor environmental conditions and extend the reach of land and biodiversity conservation organizations; and that engage landowners in the private, public and NGO sectors in the landscape-scale challenges on the road ahead. If we are successful at doing so, perhaps, fifty years from now, people will look back to the beginning of the twenty-first century as a period of exceptional progress in the history of conservation.

So, what about little Charlie and his grandmother in the year 2050? We don't know exactly how the world will have changed. What we do know that if we invest our time, energy and resources today to protect our remaining open spaces and special places, there is a much better chance that Charlie's grandmother will be able to take him out after breakfast on a hike through the woods to see a soaring hawk and smell the wild rosebud azaleas. ■

FOOTNOTES

1 "a single strand of fiber": figures cited by John Shinal, et al, "At the Speed of Light," BusinessWeek, 10/9/00, page 146.

2 "Teledesic... claims that by 2005," as reported in the Spring of 2001 on the Teledesic web site, www.teledesic.com/tech/tech.htm .

3 Data from the Internet Domain Survey, conducted by the Internet Software Consortium, available in May 2001 at www.isc.org/ds/WWW-200101/index.html .

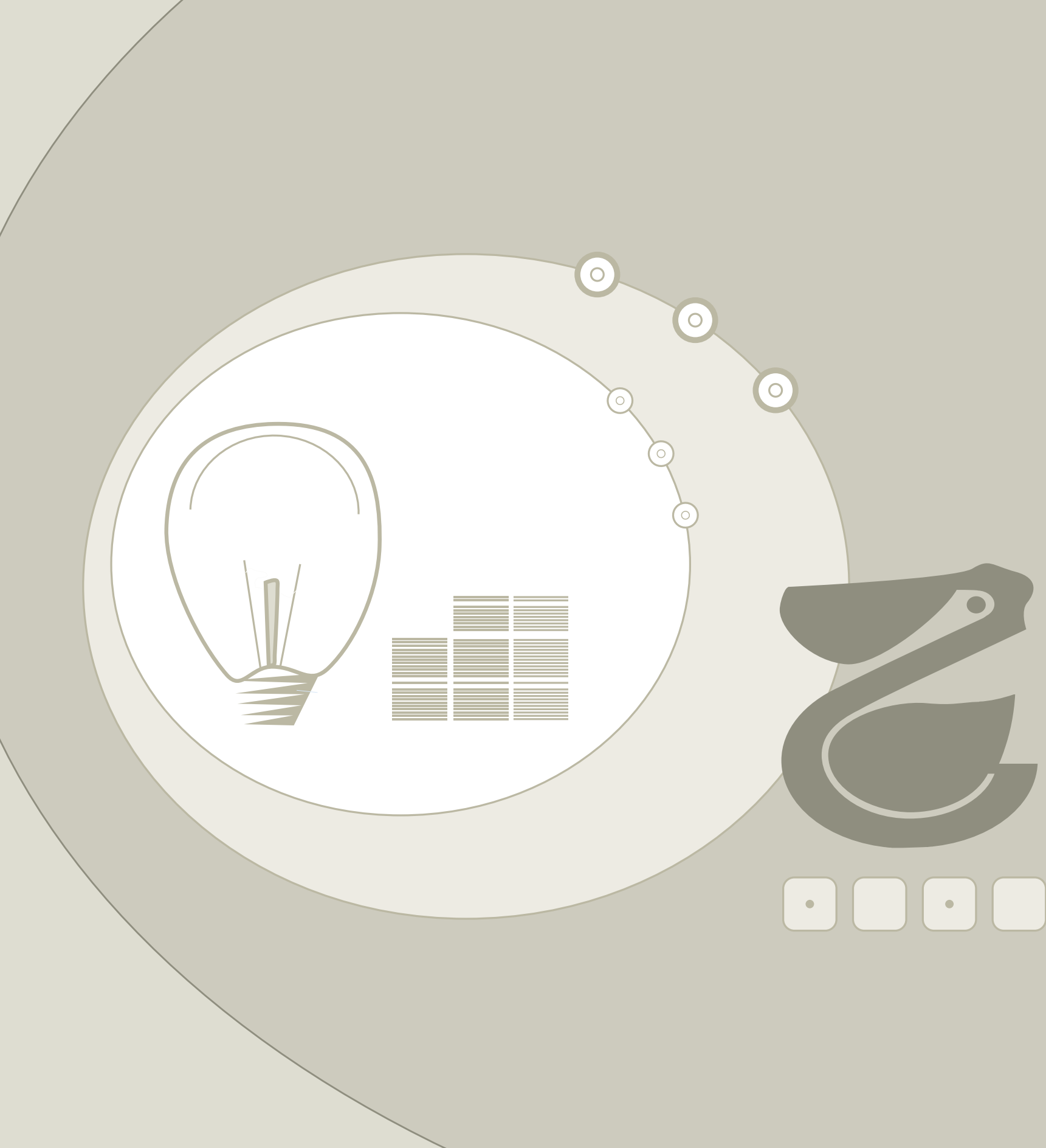
4 Computer Industry Almanac, cited in "North America Will Lose Its Lead in 2001," in The Industry Standard, available in May 2001 at www.thestandard.com/article/0.1902,22729,00.html .

5 Forrester Research, Inc. projection available in May 2001 at www.forrester.com/ER/Press/Forr Find/0,1768,0,00.html .

6 For example, see the AT&T web site on telecommuting, which presents in May 2001 the following copy along with a calculator that allows you to calculate theoretical reductions in air pollution: "Besides adding minutes or even hours to your valuable free time, telecommuting reduces the ove rall exhaust produced by automotive vehicles" (see www.att.com/telework/calculator.html). See also the work of Dr. Joseph Romm, formerly of the US Department of Energy, who claims that e-commerce can substantially reduce natural resource constraints (see, for example, the article available in May 2001 at ens.lycos.com/ens/dec99/1999L-12-10-06.html)

7 John Seely Brown and Paul Duguid. The Social Life of Information, Harvard Business School Press, 2000, page 18.

8 See, for example, the World Resources Institute article on "No End to Paperwork" available in May 2001 at www.igc.org/wri/trends/paperwk.html .



E-COMMERCE AND THE ENVIRONMENT NEVIN COHEN

In just a few years, the Internet has grown from an obscure academic tool to a worldwide community of some 300 million people. It has also emerged as an important medium of trade, particularly among businesses. Notwithstanding the recent dot-com collapse, worldwide business-to-business (B2B) e-commerce sales will grow to $8.5 trillion by 2005, and represent some 75% to 85% of the world's total e-commerce revenue.[1]

B2B e-commerce will continue to expand because it is a powerful technology that can improve the efficiency of producing and distributing goods and services. It has the potential to streamline the supply chain, from the point of resource extraction to manufacturing, shipping and residuals management. By automating production, tracking inventory more effectively, making transportation more efficient, and improving cradle to grave management, B2B solutions can result in significant environmental benefits while reducing costs.

B2B E-commerce, 2000 – 2005 (in $billions)

2000	2001	2002	2003	2004	2005
$433	$919	$1,900	$3,600	$5,900	$8,500

source: The Gartner Group, 2001[2]

INDUSTRIAL EFFICIENCIES

For example, firms can use the Internet to forecast demand more accurately, thereby reducing inventory and product waste, as well as the energy and materials required to warehouse and transport products. Using web-based programs, firms can find out exactly what product a consumer wants before it is produced, and thanks to more efficient communication via e-mail, how it is working and what modification or maintenance is needed after it is purchased.

To achieve these gains, however, transportation systems must be efficient and the e-commerce system – from the sourcing of supplies to the end-of-life management of products – must be designed with environmental considerations in mind. One study of computer manufacturing illustrates the importance of transportation choices and product take back and recycling to reducing energy consumption.[3] The study's baseline analysis was a traditional commerce model for desktop computers, in which manufacturers predict demand based on sales data, mass produce machines, and then warehouse them and then ship them to intermediary warehouses, where they are then transported to retail stores. In this scenario, consumers are assumed to do comparative shopping and transport their purchase home by car. The entire cycle from the manufacturer to the home consumes an estimated 6004 Mega Joules (MJ) of energy.

Hypothetical Energy Consumption for Computer Production and Sales (in Mega Joules)

	Traditional Model	Integrated Model with Air Shipping	Integrated Model with Ground Shipping
Materials	2913	2622	2622
Manufacturing			
- warehouse	2	1.6	1.6
- production	2920	2628	2628
Distribution (transportation from manufacturer to distributor to retailer)	105	587	84
Retail Store	4	3.5	3.5
Delivery to Consumer	60	2	2
Reuse/Recovery	0	-21	-21
Total Energy Consumed	6004	5823	5320
Percent Energy Saved		3% saved	11% saved

source: Caudill et al., 2000[4]

An integrated e-commerce scenario combines retail online sales with B2B e-commerce methods for procurement of materials and components, along with management of the computer at the end of life to encourage reuse and recycling. Integrating B2B and B2C results in energy savings from reduced manufacturing waste, overproduction, and warehousing, as well as savings in materials reclaimed from old computers taken back by the producer. In this scenario, energy consumption is 5823 MJ if shipped by air and 5320 if delivered by truck: a 3% or 11% energy savings. Of course, e-commerce merely facilitates efficient manufacturing, transport, and product take back. The development of a recycling infrastructure to recover products after their useful lives, and product take back requirements, are necessary to realize these gains.

The savings from internet-enabled logistics are more than just hypothetical. Toyota's just-in-time delivery system uses the internet to determine which parts are required where, and at what time, and then converts this information into orders for hundreds of suppliers. The system is able to reduce plant inventories by 28% and energy-consuming warehouse space by 37% (Romm, 1999). Ernst & Young has estimated that collaborative planning systems between manufacturers and suppliers could reduce inventories by $250 to $350 billion across the U.S. economy (Ibid).

One of the best opportunities for reducing energy consumption is through the use of the internet to improve shipping systems. Mark Greenleaf, e-commerce strategy manager at Ford Motor Company, has noted that in the automobile business, trucks travel at only 40% capacity at any given time. Ford is investing in internet-based logistics solutions and telematics to dramatically increase the capacity utilization of its shippers, reducing the transportation energy required per item shipped. According to a recent white paper published by the Volpe institute, US firms have been able to cut logistics expenditures in half by incorporating information technology. Experts estimate that IT has played a significant role in reducing expenditures on logistics from 20% of US GDP in 1960 to 10.5% as of 1996.[6]

DEMATERIALIZATION

The Internet is beginning to displace a wide range of printed materials, from textbooks and corporate brochures to encyclopedias. The technology for displaying text on a computer screen will have to improve before electronic books make substantial inroads into the market for printed text, but as dedicated electronic reading devices are improved and made more user-friendly, more and more people will opt to read electronic versions of paper documents.

With paper one of the most energy- and resource-intensive industries in the economy, the environmental savings could be substantial. Including transportation, production and raw materials, the carbon dioxide reductions achieved for each ton of paper avoided are estimated at 3.3 metric tons for newspapers and 3.8 for office paper. According to one study by the Boston Consulting Group, the internet will reduce demand for paper in the US by 2.7 million tons by 2003.[7] Calculations by the Center for Energy & Climate Solutions estimates such a reduction would be the equivalent of removing 2 million cars from the road, cutting annual emissions of carbon dioxide by 10 million metric tons.

One example, the lowly telephone book, illustrates the possibilities. Approximately 470,000 tons of telephone books are discarded each year in the United States, yet only 10 percent are recycled.[8] The main functions of the telephone book—data storage and retrieval—are performed far more efficiently online than on paper. Telephone books go out of date each year, but electronic versions can be updated continuously. Online directories are national in scope, offer various searching capabilities, and require no ink, paper, or delivery vehicles.

Travel guides, textbooks, and instruction manuals are other documents

well suited for electronic formats. They require constant updating, a process that can be performed electronically without producing waste. Custom publishing, one of the fastest-growing areas of the college textbook business, is another example of how e-commerce business models can also result in waste reduction. As publishing on demand expands, the industry may be able to eliminate overstock in sectors other than textbooks.

THE PAPERLESS OFFICE REDUX

While paper consumption is unlikely to decrease in the near future, electronic business applications can help stem the increase in paper use, and related energy and materials consumed to print, store, transport and dispose of bills, contracts, and other physical records of internal business transactions. The Universal Postal Union estimates that e-mail will displace 12 percent of the flow of business-to-business mail in Western Europe and North America by 2005, and 5 percent of business-to-consumer mail. And electronic billing is growing in acceptance, in large measure because it saves an estimated 50 to 75 cents per bill in envelopes and postage, and another $1 in handling costs.[9]

For example, Ericsson is changing its corporate procurement into a paperless, automated system that is saving money and cutting paper consumption. The centerpiece of the system is a wallet-sized plastic card, known as a purchasing or p-card. Staff use p-cards to pay for purchases according to predefined parameters. The cost savings are enormous, with an average cost per p-card transaction of $15, compared to $91 using traditional methods of payment. A large gain was realized when Ericsson moved its procurement system onto a corporate intranet, which eliminated much of the paperwork. At the end of every month, Ericsson receives two electronic files from its p-card provider, American Express -- an invoice, along with a breakdown of spending card by card, department by department, cost center by cost center.[10]

The British insurance company Royal & SunAlliance claims that its online procurement system has improved the efficiency of its purchasing and is saving 1.7 million sheets of paper a year. According to the Center for Energy & Climate Solutions, Cisco estimated it saved $50 million a year by storing its product and pricing information on the Web. Digital Equipment Corporation estimated that putting its promotional materials online saved $4.5 million annually in catalog and mailing costs. AT&T has cut annual paper consumption by more than 400 tons by changing from a 1,500 page paper personnel guide to an online resource.[12]

Annual US Consumer Electronic Bills Paid, 1999 to 2004

	Total Households Enrolled in Electronic Bill Presentment and Payment (millions)	Electronic bills paid as % of total consumer bills
1999	.13	0.01%
2000	.62	0.04%
2001	2.12	0.56%
2002	6.0	2.98%
2003	13.04	7.61%
2004	20.70	13.08%

source: PriceWaterhouseCoopers, 2000[13]

The impacts of moving transactions online may extend to the physical structures traditionally used to process paper. According to James Culberson, President of the American Bankers Association, half of all financial transactions in the U.S. will soon be conducted electronically, with one-third of all bank branches closing as a result. The number of travel agencies in the US has declined dramatically over the past several years, in large measure due to the use of online booking services.[14] Consolidating the functions of banks, insurance offices, and ticket agencies into fewer physical structures will reduce the energy consumed by these facilities.

SMART GREEN PRODUCTS

Forward-thinking companies are redesigning products so that they can receive information from the Internet and be controlled externally. This technology has the potential to make products far more effective, efficient, safe, and long-lasting, with all the attendant environmental and health benefits.

One recent example is the use of internet-connected thermostats to shave peak load energy demand to avert the need to construct new power generating facilities. In Long Island, New York, the power authority has just instituted a program using wireless technology to remotely control central air conditioners via a two-way, internet-based system. Under the program, 5,000 residential customers will receive an internet-connected thermostat made by the Carrier Corporation that will enable them to fine tune their air conditioners, as well as allow the utility to remotely control the units on peak summer demand days. The authority estimates that the thermostats will enable consumers to save 10-15% of their energy costs and save 5 megawatts of electricity during each peak

period. When the program is fully operational, 30,000 residential and small businesses will participate, saving an estimated 30 megawatts of summer peak demand –an amount equivalent to an additional turbine generator.[15]

Rome-based Merloni Elettrodomestici, the fourth largest household-appliance vendor in Europe, has developed a line of digital refrigerators, washing machines and dishwashers with remote Internet-control features that save energy by allowing homeowners and local utilities to monitor the power consumption of each appliance. Using web-based micro-management, individual appliances can be powered-down during peak loads and programmed to operate during off-peak periods when utilities have excess generating capacity. With the right economic incentives, this can save consumers money, cut energy use, avert the need for utility grid brownouts and blackouts and relieve pressure to build new generators.

The development of inexpensive radio frequency tags to identify the products to which they are attached may enable us to more accurately track their movement through commerce and into final recycling, reuse, or disposal systems, automating producer responsibility programs. According to John Seeley Brown and David Rejeski, manufacturing systems could be designed to keep track of products, manage inventories better, alert operators when products need repair or replacement, and enable manufacturers to ensure that they make their way back to the appropriate facility for remanufacturing or recycling. Other environmental applications are being developed, from vehicles equipped with sensors that monitor and control their emissions to sensors to help farmers optimize their water and fertilizer use and minimize the use of chemical pesticides.[16]

The Internet also makes it easier for firms to continue providing customers with information and advice after they make a purchase. Suppliers can provide product updates, recall information, and instructions on safe product use, proper maintenance for optimal performance and energy efficiency, and options for recycling, refurbishing, and disposal.

"SERVICIZING" FOR EFFICIENT USE

The internet helps businesses to shift from simply selling products to offering the functionality of their products, which the Boston-based Tellus Institute has called 'servicizing,' on a more environmentally-efficient fee-for-service basis. For example, Electrolux is piloting a service-oriented business model with a view toward offering competitive products that reduce the environmental

impacts associated with their use. One offering that has emerged from this is a digital pay-per-use washing machine that provides the functionality of clothes washing without actual ownership of the appliance.

In a pilot program on the Swedish island of Gotland that was launched in November 1999, 50 households were provided with Electrolux's energy-efficient digital washer. Participants are charged approximately $55 for the installation plus $1.12 per wash - a variable fee that appears on their monthly electric bill. Computers connect the machines to a central database and so-called 'smart energy meters' in every home. This allows the local energy utility and Electrolux to track usage and to analyze energy consumption. Electrolux services the machines and replaces them after 1,000 washes (about 4-5 years for a normal family). Used washers will be recycled or refurbished and resold by distributors.[17]

According to research conducted by Electrolux, families with "pay per wash" plan their laundry more effectively. For families, this means savings. For the environment, this means reduced energy use. According to research for the European Commission, roughly 90 percent of the environmental impacts of a washing machine come from actual use, not manufacturing or disposal. Encouraging more efficient washing practices, and regularly upgrading machines, is likely to save energy, water and detergent and also to extend the life of the appliance. In locations with high peak electricity demand, utilities could also offer incentives for consumers to run the machines off-peak, thus helping to shave peak energy demand and averting the need to build more generating capacity.[18]

GREEN BUYING

The industrial secondary materials market has also migrated to the Web. Numerous sites help companies find buyers for materials they no longer need, reducing waste disposal costs and generating revenue at the same time. One company, RecycleNet Corp., is a B2B exchange in which companies can list materials for sale or purchase. At the end of 2000, the company reported $2 million in revenues for the year, a 250% increase over fiscal 1999. A wide range of materials can be bought and sold at the company's Web site, recycle.net, including scrap metals, plastics, paper, used equipment and surplus inventory. Users can log into the website to find either buyers or sellers of products.

E-commerce solutions can also make ecological purchasing much easier for businesses and government agencies who have institutional commitments or regulatory mandates to buy green. Green B2B websites can give eco-

logical comparison shopping an entirely new dimension, both automating it and making it virtually transparent to purchasing agents. First generation websites like www.greenorder.com offer comprehensive catalogues of green products. In the future, computer search engines may be able to scour web sites by key words, concepts, amounts, or virtually any criterion that can be defined by words or numbers – including green characteristics like energy efficiency and recyclability.

The sheer ease with which the Internet allows for searching, sorting, and filtering information also makes it much easier for environmental organizations or socially responsible investment firms running a "green" search engine to target for boycotts a bad product or a company whose practices are environmentally unsound.

WHAT ARE THE REBOUND EFFECTS?

Futurists have failed miserably at predicting the impacts of technology. Forecasts in the 1970s of the paperless office were clearly wrong. Between 1988 and 1998, as the computer became not only ubiquitous but also capable of storing far greater amounts of data, the average per capita consumption of printing and writing paper in industrial countries shot up by 24%. Paper consumption continues to increase on a per capita basis and in absolute tons even during the late 1990s, a time when personal computers diffused widely through businesses.[19]

Office Paper Consumption in the US, 1997 to 1999 (in thousands of tons)

1997	14,169.9
1998	14,275.5
1999	14,829.7

source: American Forest and Paper Association, 2000.[20]

At this early stage in the transition to e-commerce, precise predictions of its environmental consequences are impossible to make. Both the practice of e-commerce and its underlying technology are evolving rapidly. As a result, the long-term impacts of e-commerce — including its effects on product design, packaging, energy, transportation, and land use — are still unknown.

Limiting our analysis to too narrow a geographic area can also result in distorted results. While e-commerce has the potential to improve efficiency at the firm level, its ability to facilitate global production in dispersed locations may

have negative environmental impacts. Shifting production processes to distant countries can lead to an increased volume of transport. And, efficiencies achieved by multinational firms may be achieved at the expense of smaller suppliers who may have to maintain larger inventories in their facilities to ensure just-in-time deliveries of parts. Furthermore, just-in-time systems rely heavily on overnight air freight movement, which is much more energy intensive than slower transport modes.[21]

And, we should not underestimate the power of physical interaction in physical space. While some analysts have forecast that the internet would reduce demand for commercial real estate as online ventures substituted for traditional downtown businesses like travel agencies, banks, insurance companies and bookstores, there is little empirical evidence to support this theory. In fact, the trend may be in the opposite direction. As Berkeley geographer Matthew Zook has pointed out, in 1999 50 of the top 100 revenue-producing dot com firms were pure play internet companies (with no storefronts). In 2000, only 30 of the top 100 internet firms had no physical presence. Indeed, some of the urban areas that have benefited most from the internet economy have actually seen a huge demand for offices, server farms, and warehouse space.[22]

An even larger unanswered question is whether there will be a "rebound effect" resulting from the efficiency improvements. If e-commerce streamlines business and lowers costs, will it lower prices, increase aggregate consumption, and thereby wipe out any environmental benefits? Moreover, some of the efficiency gains achievable through internet-enabled processes are simply marginal improvements to inherently unsustainable production and distribution systems.[23] For example, using telematic applications to increase freight capacity may save diesel fuel in the short run, but ultimately only a transportation system based on renewable, non-polluting resources – perhaps fuel cells powered by solar-generated hydrogen -- will be truly sustainable.

DESIGNING A SUSTAINABLE DIGITAL ECONOMY

An awareness of both the benefits and potential environmental pitfalls of e-commerce can help us avoid the most adverse effects. Proactive steps taken by consumers, industry, and government can ensure that the new business models of the wired economy improve on traditional business practices rather than make matters worse.

Because business-to-business e-commerce accounts for the lion's share of total e-commerce revenue, some of the biggest environmental gains will be

achieved by greening online practices in the B2B sector. An important step would be the adoption of an e-commerce code of practice that improves transportation logistics, reduces packaging and product waste, and increases environmental transparency, committing companies to the following ten steps:

1. Using the most energy-efficient product delivery systems.
2. Encouraging shippers to use alternative fuels.
3. Developing environmentally sound, reusable and recyclable packaging.
4. Designing products that are efficient to ship (e.g., concentrates).
5. Marketing the environmental benefits of electronic versions of physical products such as digital images, music, and books.
6. Encouraging electronic payment of bills and putting manuals and forms on-line.
7. Committing to product take back programs and designing internet-based product tracking systems.
8. Developing a consistent set of product descriptors that define the environ mental characteristics of products sold on-line so that purchasing agents can scan for qualities like energy efficiency and chemical composition.
9. Developing an international code of practices to prevent the illegal trade in hazardous substances, banned products, or pharmaceuticals.
10. Tracking and reporting the impacts of e-commerce systems in annual environmental reports. Only with comprehensive data on transportation patterns and shipping logistics, product design, consumer behavior, and resource consumption will we be able to put in place the programs and policies to ensure that electronic commerce produces positive environ mental impacts.

Consumers also can play a role by demanding that online vendors provide products, packaging, and delivery systems that are as environmentally sound as possible. When Amazon.com partnered with Federal Express to deliver more than a quarter of a million copies of Harry Potter and the Goblet of Fire across the United States on its release date, the effort required a dedicated fleet of 100 airplanes and 9000 trucks to move the books packaged in individual corrugated cartons.[24] Consumers must ask online vendors to not only avoid such environmentally wasteful practices, but to design reusable packaging and demand that their shippers avoid air transport and use alternatively-fueled delivery vehicles. Ultimately, consumers must use the internet to substitute for, not augment, automobile-based shopping trips. ■

FOOTNOTES

1 Cohen, Nevin. 2001. The eGlobal Report, August 2001. NYC: eMarketer, Incorporated. p. 117.

2 Ibid Gartner defines B2B e-commerce as the sale of goods and services for which the order-taking process is completed via the Internet, including purchases via Internet-based EDI systems.

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5 Greenleaf, Mark. 2000. Presentation at Joint New York Academy of Sciences and Tellus Institute Symposium on E-commerce and the Environment, October 2000. New York City.

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12 Romm, op. cit.

13 PriceWaterhouse Coopers, Projecting Electronic Diversion for First-Class Mail in the H.R. 22 Simulation Model, US Postal Service, Feb. 7, 2000.

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15 Carrier Corporation website.

16 Seely Brown, John and David Rejeski. Ecological Computing The Industry Standard. December 18, 2000

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19 see Abramovitz, J.N. and A.T. Mattoon. 1999. Paper cuts: Recovering the paper landscape. Worldwatch Paper 149. Worldwatch Institute, Washington D.C.

20 cited in PaperCom Alliance Index Report, November 27, 2000.

21 Fichter, Klaus. 2000. Sustainable Business Strategies in the Internet Economy. Berlin: INF Institute for Innovation.

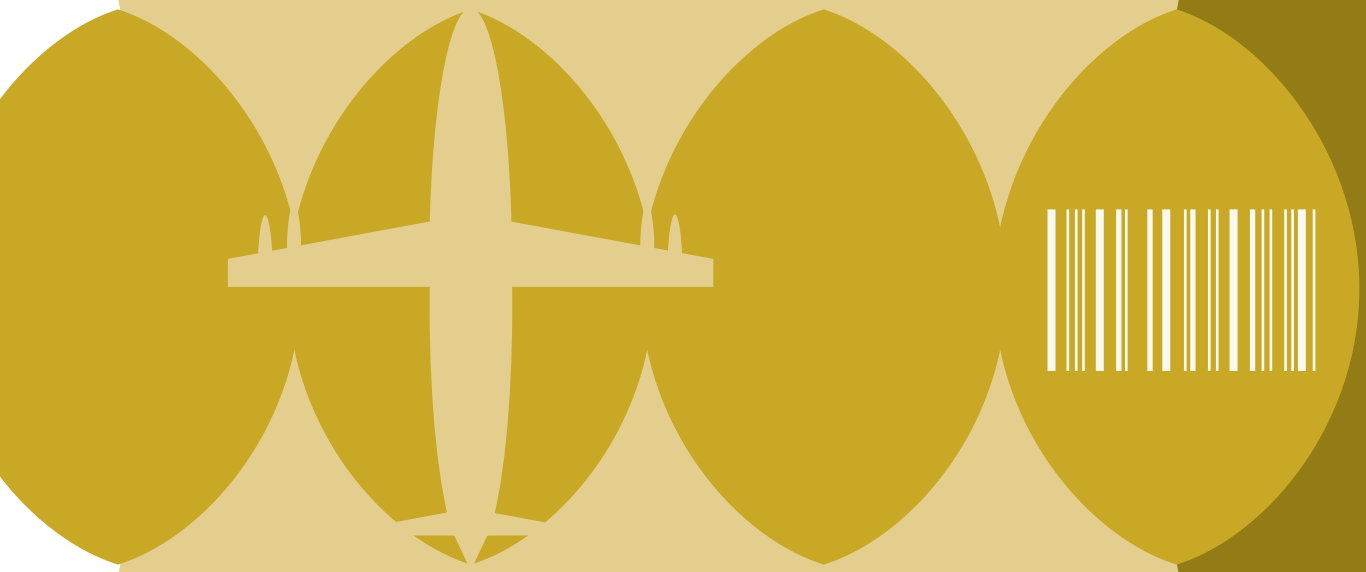
22 Zook M, 2000, "The web of consumption: the spatial organization of the Internet industry in the United States" Environment and Planning A. Data on pure-play internet companies presented at conference on the Internet and Cities at New York University.

23 The hardware comprising the internet is not environmentally benign. Figures from the European Union's waste electrical and electronic equipment (WEEE) directive show that in 1998, 6 million tons of waste electrical and electronic equipment were generated in Europe, amounting to 4% of the municipal waste stream, a volume that is expected to increase by at least 3-5% per annum.

24 Hendrickson, Chris T., Matthews, H. Scott, and Soh, Denise L. 2000. Environmental and Economic Effects of E-Commerce: A Case Study of Book Publishing and Retail Logistics

- Recycle OK, but Leave my Frequent Flyer Miles Alone!

CAN VIRTUAL MEETINGS REPLACE BUSINESS TRAVEL? PETER ARNFALK



Can technology replace a physical meeting? In many instances it can, but the answer to this question is far from trivial. In this chapter, the potential of Information and Communication Technology (ICT) and so-called 'virtual meetings' potential in tackling the fast-growing trend of business traveling will be discussed. But first some words about why this is relevant.

TRAVELING AND GLOBAL CLIMATE CHANGE

It's getting warmer. During the last four decades, the global average temperature has risen 0.1 C per decade. Climate models project that this increase will continue and that the globally averaged temperature may increase by 1.4 to 5.5 C over the period 1990 to 2100. (IPCC, 2001). Global Climate Change is caused primarily by carbon dioxide (CO2) emissions from anthropogenic activities such as the burning of fossil fuel. During the past 20 years, about three-quarters of anthropogenic emissions of CO2 have been due to fossil fuel burning (IPCC, 2001).

One of the most important reasons for this trend is traffic growth. As most means of transportation use fossil fuel as their energy source, transport has become one of the major contributors, not only to climate change, but also to several other important environmental impacts: acidification, eutrophication, local air pollution, loss in biodiversity and noise. In the EU, CO2 transport emissions have increased by 40% since 1985 as a result of traffic growth (in particular of road and air traffic), the use of heavier and more powerful cars, and the linked growth in energy consumption. Emissions are expected to increase by a further 30% by 2010, making transportation the single largest contributor to EU greenhouse gas emissions. If the prediction proves right, this would jeopardize the possibilities to achieve the reduction target in greenhouse gas emissions agreed under the Kyoto protocol (a total decrease in CO2 emissions by 8% in the EU): (EEA 2000).

On a global scale, passenger air travel is projected to grow about 5% per year between 1990 and 2015[2] , whereas total aviation fuel consumption is projected to increase by 3% per year. Scenarios of the emissions from aviation year 2050, predict an increase of CO2 emissions ranging from 1.6 to 10 times the value in 1992 (IPCC, 1999).

TRAVELING IMPACT MITIGATION OPTIONS

So what options are available if we decide to set about reducing emissions from the transport sector? Ministers in the OECD countries have recognized the problem and called on the OECD to develop guidelines for moving towards sustainable transport (EST). In the developed guidelines, it is concluded that a 'business-as-usual' approach in transport policy and practice is no longer a viable option. As a result, a 'toolbox' of suggestions on how to approach the problem are given. These include changes in the tech-

nology of vehicles, fuels and infrastructure, and transport activity and management. The latter involves:

- favoring a higher share and use of environmentally sound and health beneficial modes;
- increasing the loading and occupancy of vehicles;
- providing information and education about the efficient use of transport;
- changing mobility patterns and driver behavior, and;
- reducing the need for motorized transport.

The selected instruments should: "...secure the needed changes in transport activity, through demand management, which could include incentives to reduce the need for travel and provide alternatives to individual ownership and use of vehicles." (OECD, 2000).

In the EU, similar conclusions have been drawn. The European Environmental Agency (EEA) has monitored the trend in different transport policy issues in the 1990s, and concludes: "Rapidly growing transport volumes, especially for road transport and aviation, have over the past decades offset environmental gains from technology improvements. Demand management policies are needed to de-link transport growth from economic growth and to improve the balance between various modes of transport" (EEA, 2000).

Can the use of Information and Communication Technology (ICT) help in providing the sought-after de-coupling of transport growth and economic growth, by providing various alternatives to physical transport? Numerous policy makers have expressed great expectations that this could be the case, and particularly within the electronics and telecom business, it has become a 'conventional wisdom'. However, at the same time as we have experienced an exponential growth in the number of computers, telephones and Internet connections, the demand for transport has been growing rapidly as well. It is not unrealistic to interpret these two parallel developments as being ICT that accelerates traffic growth, by 'speeding up' our lives, supporting the globalization development, and making people more mobile in their business and during their leisure time. This relationship has long been emphasized by, among others, Salomon and Mokhtarian (see e.g. Salomon, 1986 and Mokhtarian, 1996). It is most likely that we experience these rebound-effects because the main driving forces behind the growing use of ICT is not environmental concern, but rather drivers such as convenience and attractiveness of the new

technical innovations, combined corporate issues like competitiveness, time-to-market, increased profit margin and market share, etc.

As ICT is becoming an increasingly influential and natural part of our professional and private lives, it would be unwise to disregard its use when trying to accomplish more sustainable transport consumption. Halting the use of ICT is not a viable option, so we need to look into opportunities for altering the way we are using the technology and to grasp the potential to 'move bits instead of atoms' (Negroponte, 1995). This can be considered as a kind of 'dematerialization' of the transport sector.

One of the more promising applications of ICT to realize this dematerialization potential, is the substitution of business travel with teleconferencing, i.e. audioconferencing, videoconferencing, and on-line collaboration via computers. In the following section, the possibilities and limitations of using these technologies, specifically in business communication, will be discussed.

What is a Virtual Meeting?

Virtual meetings are ICT supported meetings, where two or more persons use the technology to communicate instead of meeting physically. In this context only business meetings are considered, and meetings that would actually replace the need for one or more persons to make a trip.

Virtual meetings basically rely on three technology applications: audioconferencing, videoconferencing, and on-line collaboration via computers, jointly called collaborative technologies. A brief explanation of the applications is given below.

Audioconferencing

Most telephone conversation takes place between two persons, however, a normal telephone call is generally not considered as virtual meeting. If a meeting with more than two persons is to take place, a multi user audio conference call can be used, connecting three or more telephones connected at the same time. Another option is to connect a conference telephone, a type of telephone with speaker function that allows a group of persons in one place to communicate via the phone. These two options are called audioconferencing.

Videoconferencing & On-line Collaboration

The big drawback of audioconferencing is that you cannot see whom you are talking to. This problem is taken care of by videoconferencing, in which two or more places are connected via special equipment that allows the participants to both listen and to see each other. Within the concept of videoconferencing, there are mainly three types that are commercially available:

- Desktop Systems for point-to-point conferences
- Group Systems:
  - Rollabout systems for 3 to 6 users
  - Room-sized systems for as many as 25 users

A Group System is basically a big television and a camera. In addition, electronic whiteboards, document cameras, and computers can be connected to the equipment to complement and enhance the communication. Using this system, several persons can participate at each end. Also here, multi-user conferences can be held.

Desk-top or Personal Videoconferencing, usually consist of a computer, equipped with a small camera, microphone, a video- and audio circuit board and a special software. With this equipment, 1-2 persons can communicate at each computer. Multi-user conferences are possible, as several computers can be connected simultaneously.

On-line Collaboration, that makes it possible for a group of persons to simultaneously and remotely edit the same document, draw pictures, give oral and visual presentations etc. Communication via Internet offers a nearly unlimited range of options, and this technology develops very quickly. However, the limited quality restricts the professional use.

WHY VIRTUAL MEETINGS?

should I stay or should I go (Clash, 1982)

According to figures from the World Tourism Organization, in 1998 business travel accounted for 18% of the total number of international arrivals of visitors (WTO, 2000). Further, the World Tourist and Travel Council (WTTC), tells us that from 1988 to 2000, business travel has increased 60% worldwide, and is expected to continue to grow strongly (WTTC, 2001). In spite of that business travel is outsized in volume by leisure travel, business travelers often pay considerably more for their trips, and thus constitute an important driver in the growth of the travel economy. There are several arguments supporting a development in which virtual meetings substitute a sizeable part of this business traveling. Some of these arguments are presented below, along with some of the barriers this development faces.

Environmental concern

The environmental argument is important and gradually becoming even more so. A triggering factor is the growing number of companies introducing an environmental management systems (EMS)[3]. In doing so, the company has to identify its most significant environmental aspects, or: look into how and from where its major environmental impacts come. Particularly, for the rapidly growing number of service companies, transport is often a dominant source for environmental impact, and the EMS then attracts the attention for action to be taken to reduce these impacts.

Virtual meetings and the collaborative technologies that make them possible have an environmental impact themselves. This impact can be seen in relation to the alternatives. When making a comparison between the alternatives of having an audioconference or going on a physical trip, the energy consumption of the trip vastly exceeds that of the virtual alternatives. (BT, 1991). Chalmers Industriteknik conducted a Life Cycle Assessment (LCA) comparing the environmental impact of a videoconference between two offices in Gothenburg and Stockholm, with that of a (one person) trip by air and by train. This extensive LCA includes seven different impact categories and is divided into three levels of life cycle boundary and two scenarios. The results indicate that a trip by air has at least a fivefold higher impact than videoconferencing in all categories. In most cases, videoconferencing had much less impact than the train trip. However, in a 'worst case scenario' (where the videoconferencing

equipment is left in stand-by mode all the time and used very rarely), a train trip can compete with a videoconference and even have less impact[4] (Eriksson and Östermark, 1998).

Other drivers

But the environmental driver is not sufficient. The reason why companies, universities, municipalities, governmental institutions, and other larger organizations are gradually increasing their use of virtual meetings is mainly to save time, improve efficiency, reduce costs and for the sake of convenience. The time saving argument is often the strongest one, and this also ties into the organization's efficiency, cost and convenience. A key factor is that it enables valuable key persons to ease their often heavily crowded travel schedules and become more 'available' to their own organizations. It can also give geographically remote persons, working in an inter- or intra-organizational project, the possibility to maintain a good and frequent communication flow throughout the project.

BMW is one example: the company has used different virtual communication channels, throughout the process of making their BMW X5 model. To promote the use of virtual communication even further, the company is requiring all of its suppliers to enable their operations with videoconferencing and other technologies. Benefits from this program are expected to be significant. But it is not primarily cost reductions, or improved environmental performance from decreased traveling that appears to be of key importance for the management; rather it is the possibility of slashing product development time by as much as 50%, though the creation of a 24-hour, global, product design-team (Rosen, 1999).

In addition to product development, virtual meetings are used for a range of other applications in companies all over the world including: recruitment, telecommuting, virtual help desks, training, project management, remote expert/consulting, maintenance, emergency management, and document production (Rosen, 1996).

Cutting costs is also an important factor. The average annual travel cost per U.S. business traveller is about US$ 9000 (NBTA 2001). The cost of 'business travel related activities', including both travel and entertainment, in 1999 amounted to US$ 396 billion dollar in the US alone. The scale of the issue may be emphasized by the fact that in US and Canadian companies, business travel has soared to become, on average, the second or third largest controllable

cost (Gibbs, 2000 and CMA Management, 1999). The total cost for an audioconference or a videoconference (including costs for equipment, telecom, support, services, studio and host for videoconference) can be compared with that of a business trip (including traveling, hotel, allowance, loss of working time, travel administration etc.). In Figure 1, a comparison of the costs is displayed.

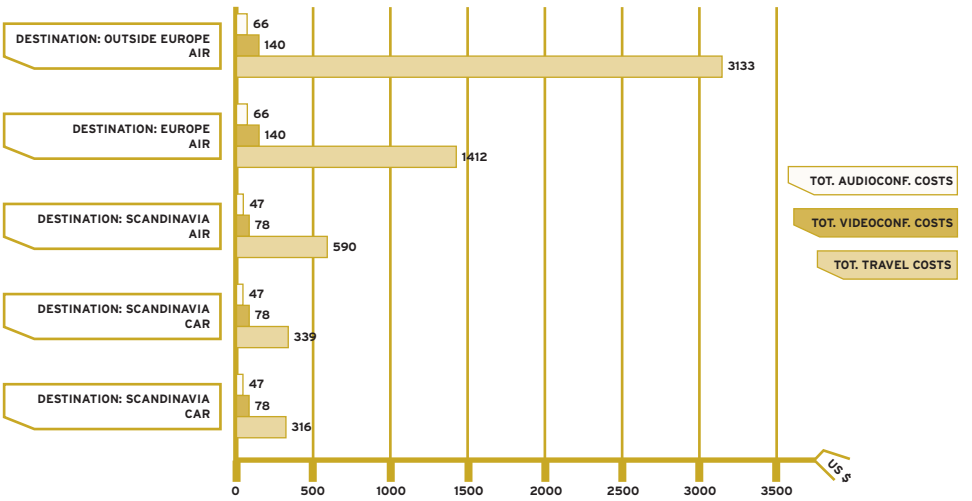


Figure 1. A scenario estimating the total costs[5] for one person attending a business meeting. The figure shows a comparison of the total cost for traveling from a destination within Scandinavia to different locations, using various modes of transportation, and having a virtual meeting with these locations (Arnfalk, 1999).

The money spent feeds the world's largest industry; Travel & Tourism. In 2001, this business is expected to generate approx. US$ 4,500 billion of economic activity world wide, equivalent to 4.2% of the world's Gross Domestic Product (GDP). Travel & Tourism demand is expected to grow 4.0% per annum to US$ 9,300 billion by 2011 (WTTC, 2001). This can be compared to the virtual meetings market now growing at 37% per year and expected to reach US$ 39 billion by 2002.

A concrete case is the internal use of audioconferencing at the major Swedish telecom company group Telia AB, and its subsidiary Telia Nära. The top management started using audioconferencing combined with NetMeeting for three out of four quarterly meetings involving 60-70 managers all over the country. For these meetings alone, the company saved 3 million SEK (approx. US$ 300,000) in reduced costs for travel, hotel and loss of working time in two years. Furthermore, the use of audioconferencing was promoted and systematically implemented in the rest of the organization; thereby the use increased 140% during the same period of time. In a survey conducted at Telia Nära in 2001, 98% of the respondents were using audioconferencing, on average

about 100 times per year (Arnfalk and Kogg, 2001). At the same time as the use of virtual meetings has increased, the number of trips by air has decreased considerably, and plunged 20% 1999-2000 (Telia, 2001).

Barriers for change

How come, that despite a multitude of convincing arguments supporting the use of virtual meetings, the growth of these applications is relatively limited?

The answer to this question is complex and many factors affect the development, including e.g. personal, organizational, and public policy issues. An attempt to map the different factors influencing meeting behavior at a company has been made, in Figure 2 (Kogg and Arnfalk, 2001).

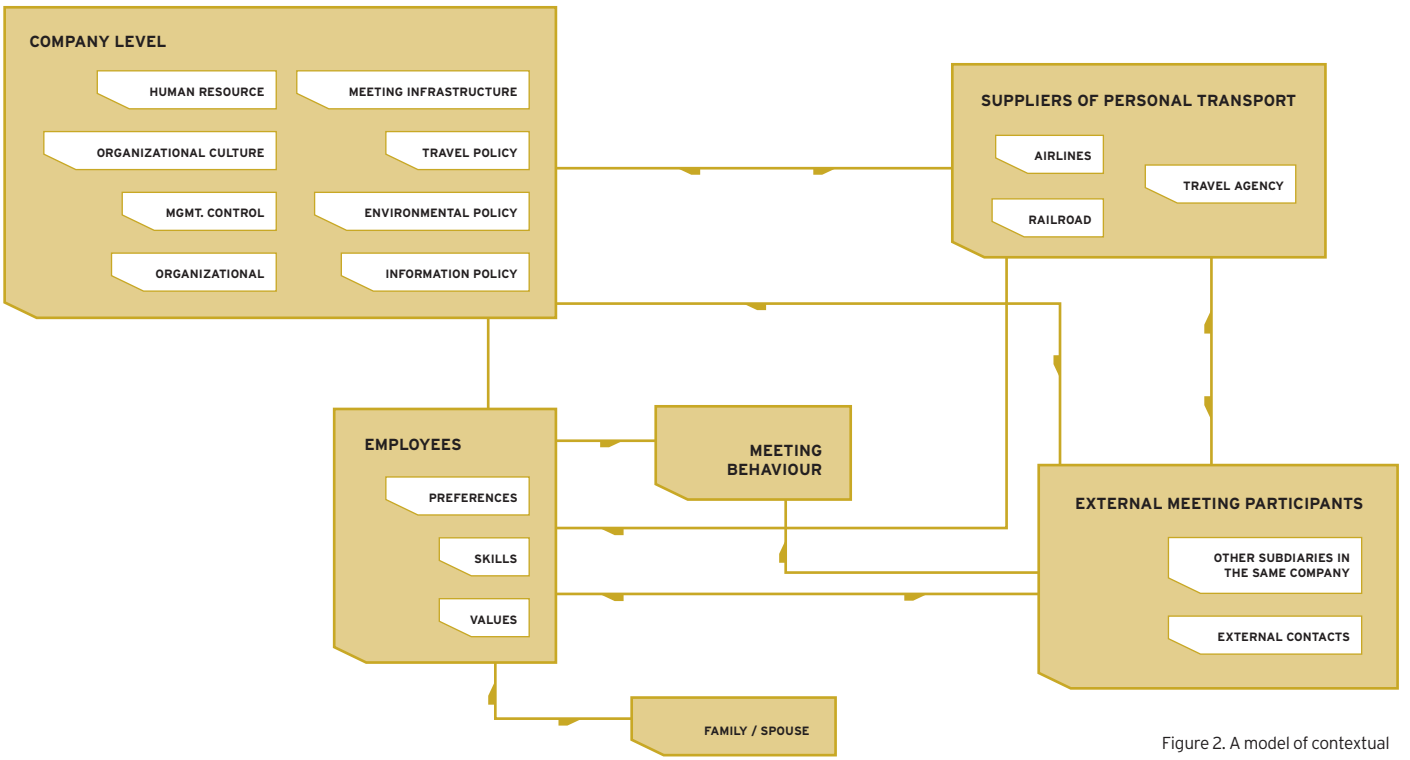


Figure 2. A model of contextual factors for meeting behaviour at TRAB (Kogg and Arnfalk, 2001)

However, only two factors will be discussed here. One is the technology's inability to fully replace a physical meeting, and one is simply that we like to travel, go to new places and meet new people. I will try to explain these somewhat in more detail.

Barrier I: Technology

Even though the telephone has been around for more than a century, teleconferencing is still a relatively immature technology. This is true for both the applications videoconferencing and audioconferencing, but is an especially relevant limitation for videoconferencing. In a study of four different organizations in Sweden, videoconference users listed their problems with the medium, as shown in Figure 3. If an airline company had failure rates like these, it would not survive very long. However, the reliability of the equipment and the network has improved in recent years, and many peoples' reluctance towards videoconferencing is based on an experience they may have had 5-10 years ago. It is also noteworthy that people have very little forgiveness for a 15-minute delay in connecting a videoconference, while the frequent hour-long delays in air traffic seems to be more easily forgiven, something that is likely linked to the second barrier – our willingness to travel.

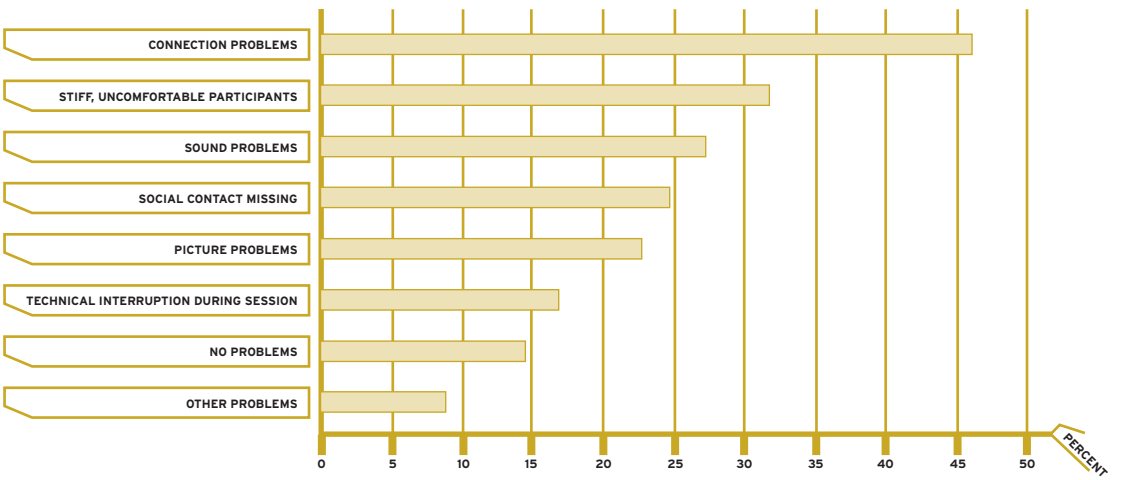


Figure 3. Problems with videoconferencing experienced averaged in four Swedish organisations: Telia AB, Skånska Lantmännen, Scandinavian Videoconferencing User Group, and Tetra Pak. (Arnfalk, 1999)

Audioconferencing has the advantage of having a very high accessibility, with more than 1 billion telephones worldwide. This figure may be compared with the number of videoconferencing facilities. There are today approximately one million business-environment videoconferencing user points worldwide, and in 1999 about 3000 of them publicly available studios worldwide (Dennis, 1999).

Combined with a better reliability, easier handling, and lower investment and operating costs, audioconferencing is becoming increasingly popular. Nevertheless, it has the fundamental drawback that you cannot see the person

or persons you are in communication with, which can create a feeling of alienation and uneasiness. This can, as for videoconferencing, be reduced or eliminated by education and training in how to manage such meetings, but this kind of training has seldom taken place.

Another drawback for virtual meetings is that they very seldom are supported by a well-oiled organization such as the one surrounding the travel industry. Booking, support during meetings, start-up and close-down, service, telephone directories etc, are given low priority and are often 'thrown' to a near-by secretary that has neither knowledge of how to run the equipment nor any interest in it. Organizations also have a tendency to foresee a number of factors and thus make sub-optimized decisions when investing in collaborative technologies. Many companies invest in poor equipment, low bandwidth, no or little manpower for support, even though the payback time for a group sized videoconference equipment in a large organization is typically about 20-30 days.[6]

A common statement regarding virtual business meetings is focusing on the personal contact: "but you know, we have to meet [physically] not to lose valuable personal contact". I agree, but not categorically. It is not a question of extremes, of not meeting each other physically at all or not. Virtual meetings provide a competitive alternative particularly to tedious, time-consuming routine meetings with persons that you have already met. The type of meeting and information that should be transferred is vastly different from the kind of impressions and sensations that you associate with a leisure trip. However, for start-up meetings, negotiations, brainstorming etc., virtual meetings are generally not suitable, with today's limitation in technology and our lack of training in handling virtual meetings. On the other hand, for short (max 2 hours) and regularly occurring meetings with the purpose of disseminating information to the participants or to follow-up on results, the virtual option can be very apt (Arnfalk and Kogg, 2001). Nevertheless, this attitude is perhaps the most important hindrance for an expanded use of virtual meetings, and is deeply and safely embedded in peoples' minds and values.

Obstacle II: traveling itself

It's far from a trivial task to move the demand side of travel towards a more sustainable level. From a societal viewpoint, growing transport volumes are on the contrary seen as something positive, and investing in transport infrastructure has for a long time been a standard solution for supporting and strengthening economic growth (Andersson and Strömquist, 1988). The coupling of trans-

port volumes and GNP has a long history and is hard to dismiss. The establishment of the World Trade Organization (WTO) is a major manifestation of the globalization trend. Within the framework of the WTO, a number of agreements have been made that will facilitate international trade. This naturally generates the need for more contacts and communication between remote parties, and thus, in turn, calls for more travel.

From an industry perspective, traveling has been a prerequisite for a company's survival as this is a means to attain and maintain customers, suppliers, retailers, partners and other business contacts. These parties need to communicate which generates a lot of meetings, of which many, in turn, require people to travel long distances to attend. Moreover, it is a way to exchange information, generate new ideas, and keep the employees happy.

In addition, the industries that benefit from traveling, i.e. petroleum, car- and aviation manufacturers, travel service providers, and construction companies, constitute a very powerful and very influential group. It is not unlikely that this group of companies is quite hesitant to welcome a drastic reduction in transportation demand.

From the individual's point of view, traveling is often considered a very positive thing. Many companies use business travel as a selling point when trying to attract or entice young recruits - "join the navy and see the world". Business travel is still surrounded by an aura of status and glamour, even though traveling for business purpose has become more and more commonplace and is no longer the privilege of top management alone. The feeling of importance when a company, considers you and your work to be so important that it is willing to spend thousands of dollars to let you travel to some remote part of the world, is enough to boost most people's egos, and signal professional success to his or her surroundings. However, in companies where most of the staff travels, the motivation is less and traveling is considered hard work that you would happily reduce (Halme et al. 2001).

Other personal drivers that help making business travel attractive are the airlines' frequent flyer programs, tax-free goods, and travel allowances. When asked whether they are influenced by these factors, very few admit that this is the case. However, a majority insist that these factors have significant impact on others frequency and mode of transport (Arnfalk, 1999). An illustrative anecdote reveals the importance of frequent flyer programs. Given a choice between immediate departure with an airline that did not provide any bonus points or waiting an extra hour for an airline that did, eighteen out of twenty employees at

a major Swedish company, flying between Oslo and Stockholm, chose the later flight (and doubled the time duration before they got home) (Kogg 2000).

REALIZING THE POTENTIAL OF VIRTUAL MEETINGS

If we expect virtual meetings to help in accomplishing a cutback in business traveling, we cannot simply invest in a lot of conference telephones, videoconferences and Internet-connected computers, sit back and hope that people will use it and stop traveling. This will not happen; in too many cases, efforts have stopped at this point with the conclusion that "it doesn't work", "nothing can replace a REAL meeting". Replacing business travel with virtual meetings is consequently not a spontaneous process, and the success depends on efforts from a number of actors in society.

Who can do what?

Individuals

A crucial component in tackling business travel is realizing how much of your personal environmental impact, or ecological footprint, that stems from transport activities. In the western world, it is often consciously or subconsciously disregarded, even among persons who are environmentally concerned in general. As discussed above, restraining the attractive freedom of personal mobility is often a much greater sacrifice than selecting eco-labeled detergent or to recycle glass bottles (Lindhqvist, 1991 and Lindén, 1996).

Another personal challenge is to overcome the natural fear many of us have for using new technical innovations, and making the effort of learning something new. We have practiced since childhood to manage the complex situation of an in-person meeting. However, to attend a virtual meeting, i.e. a videoconference, can feel very uncomfortable in the beginning, as it requires some knowledge of how to technically operate the medium, and how to behave in a situation with limited information 'density'. As much of our communication normally relies on body language, the loss of this communication has to be compensated, which requires training and skills. We tend to take much of this for granted, but it's not that trivial; my four-year old daughter still quietly nods her head to say "yes" during a telephone call, and you can see Japanese business men in Tokyo bow deeply when making a call in a public telephone. Along with improved technical performance and broader bandwidth, the 'degree of substitution' becomes higher when a videoconference replaces a physical meeting, that is, it's more like the 'real thing'. Employees at four dif-

ferent organizations were asked how well videoconferencing had been able to replace a physical meeting: the average result was approx. a 60% degree of substitution (Arnfalk, 1999). However, the impression varied strongly depending on type and purpose of the meeting, and the performance of the technology and support during the meeting. Consequently, it is important to select the optimal medium for a specific meeting situation, but also to learn how to handle the different forms of virtual meetings.

Companies; organizations

If you intend to shift some portion of an organization's business meetings to virtual meetings, and at the same time want to maintain or even improve the value that these meetings generate, you have to understand why, and how, these meetings take place, and acknowledge the complex character of business communication. The type of meetings differ between organizations, and the solutions have to be tailor-made. Nevertheless, I want to share some common success factors I've found during my research in different organizations.

1. Get access to good communication equipment and bandwidth. In smaller organizations a good conference telephone may be sufficient. In larger organizations, investing in in-house videoconferencing often proves to be a good investment, as the payback time is very short. Poor or insufficient equipment and bandwidth is a very good way of scaring away potential users. Large organizations should identify where the major needs for internal communication/traveling are and place equipment accordingly.
2. Inform everyone that the teleconference exists, where it is located, and how to operate it. Make sure that everyone has tried it at least one time, preferably more. Give a short course for managers and project leaders in how to manage a virtual meeting.
3. Make sure that someone is responsible for the virtual meetings function within the organization. Preferably this is a dedicated person who does not see this as just an extra burden that they really don't know how to handle. Set aside enough time for this person to do the job, arranging a good booking system, getting and servicing the technical equipment, offering support during meetings.
4. Create incentives for shifting the habit of always traveling to a meeting, or to expect that the participant should travel to the meeting you arrange, to think in terms of communication instead. Let employees share some of the money saved through reduced travel expenses, i.e. as a bonus to a project group or

department that has used virtual meetings for their internal communication. If the travel bureau should offer the service of booking and arranging virtual meetings as well, they need, of course, to be compensated for this.

5. Make sure that the top management promote the use of virtual meetings and lead the way themselves, so that they constitute a good example for others. This will raise the image of this form of meeting.

Another interesting approach to consolidate the different actions needed to support this shift, is to introduce the issue already at company policy level. This approach is presently being tested at a major Swedish company, in which the travel policy is being converted into a meeting policy, and the use of virtual meetings is promoted in the environmental policy. Methods for follow-up of how this actually performs in terms of substituted business trips for virtual meetings, and how well this is received among the employees, are being developed. One option that is being analyzed is to introduce meeting-specific measures in the company's balanced scorecard (Nilsson, 2001).

In line with this approach, a multinational construction company is instead of having a travel manager, converting this position to become a meeting manager. In close cooperation with their main travel bureau, they are constructing routines for ordering meetings, virtual as well as physical, from one central meeting bureau. This bureau should function as a one-stop-shop for all business meetings within the company.

Policymakers

Policymakers such as local, state, and federal governments, can play a major role in promoting the use of virtual meetings. Perhaps the most influential role they may have is to constitute a good example, and to use the technology themselves.

Obviously, policymakers can also influence transport demand through different command and control-measures (e.g. emission regulations) and internalization of external costs (e.g. environmental taxes), but this extensive area will not be developed in detail here. However, by providing a realistic alternative to business traveling, virtual meetings makes it easier for policymakers to suggest and implement restrictions to curb its exponential growth.

NGO:s role

I believe that environmentally concerned NGOs, such as the WWF, have an important role to play. First of all to they can act as model for others and lead the way. For internal communication within the organization, traveling should be held to a minimum, and the organization should be aware of, and keep track of, emissions coming from their activities. If the organization can show records of reduced traveling and emissions, it will be trustworthier in informing and educating other actors in society. The question of growing traffic volumes and the environmental impacts thereof needs to be highlighted.

'BEAM ME UP, SCOTTY' - THE FUTURE OF VIRTUAL MEETINGS

What can we expect that the future will bring in terms of teleconferencing and other forms of collaborative technologies? Some speculations are presented below.

The technical development will maintain a fast pace. Internet plays a major role, making communication cheaper, easier and more available to more people. A gradual shift has already started towards using Internet as the carrier for this type of communication. The long-lasting trend of better performance at a lower price will continue, bringing better-quality pictures at an affordable price that eventually make videoconferencing equipment as commonplace in offices as telephones, televisions, VCRs etc. are now. Already today, a web-casting camera that makes desktop videoconferencing reality costs less than 50 Euro.

Figure 4. A landmark in the development of Teleconferencing was when Bell Labs introduced the Picturephone at the World Expo in 1964; the world's first interactive video-enabled telephone. Original Caption by Science Service © Bell Telephone Laboratories

An increasingly popular technology is the full-sized wall projection, in which a person can be seen in his/her normal size. This is another step towards increasing the communication 'density', as the body language can be incorporated. Other more futuristic developments could be to see a full-size three-dimensional image projection of a person, or to have virtual reality meetings in a common computer world, where you i.e. can choose how to be dressed and where to meet (Bahamas, North pole, the Moon). Communication that stimulates other senses like smell may also complement picture and sound.

However, equally important to the technical development is our adaptation to the technology. The generation growing up with a video camera pointing at them from the time even before the umbilical cord has been cut, will grow up to become less frightened of sitting in front of a camera.

E-learning or distance education may be a driver to use 'virtual classrooms' to a larger extent. In this way, young people are getting used to managing the technology in a professional situation. Moreover, as video now enters mobile communication, the private use of a 'Picturephone' becomes commonplace

and less science fiction. This will make us feel less awkward to meet friends and business contacts virtually, and it will become gradually more natural and common to suggest a virtual meeting instead of a physical business meeting. We can think of the decision making for an occasions as being placed on a scale between the two extremes 'definitely a virtual meeting' and 'definitely a physical meeting'. As the technology is getting better, cheaper, more reliable and available, at the same time as the 'meeting-goers' are becoming increasingly used to managing virtual communication, there will be a shift on this scale for the occasions that are considered suitable for virtual meetings or not. The virtual meeting will not be a phenomenon exclusively for the top management, more like an every-day work form, like the normal telephone call is today.

EPILOG

It's hard to 'walk the talk'. I visited a large environmental conference this year to present a paper on corporate travel management. As the conference took place in Thailand and I live in Sweden, I had to go approximately 21 000 km by air to get there. There were three of us who presented the paper and all of us wanted to go there, so the presentation of this paper 'cost' more than 6600 kg CO_2.[7] The conference had attracted several hundred participants from all over the world, so the 'result' of this event added up to more than a hundred tons of CO_2 emissions. At the same time and in the same conference hotel, a large, international conference on climate change took place with more than 500 participants. All in the name of environmental protection. Let him who is without sin cast the first stone...

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FOOTNOTES

1 King Carl XVI Gustaf's 50th Birthday Foundation for Science, Technology and the Environment.

2 Measured in revenue passenger-km

3 Such as ISO 14001 and EMAS (Eco Management and Auditing System)

4 The system boundaries set up for the LCA were chosen to be intentionally unfavourable for the videoconference as compared to the two means of transport. The construction, use and scrapping of the telecom equipment and networks were included in the comparison, but this was not the case for the two transportation modes. For the train and airplane, only the use of electricity/fuel was included. When only the use of the electronic equipment was included, the impact from videocon ference was a hundredfold less. It should further be mentioned that in Sweden, where this LCA was conducted and the data gathered from, electricity is generated mainly from hydropower and nuclear power, and to a very small extent (< 5%) from fossil fuel. This made the train alternative more 'competitive' in several of the LCA impact categories, as the high-speed trains between Gothenburg-Stockholm are powered by electricity. Since this comparison was made, the Swedish rail road company SJ has started to buy electricity generated exclusively from eco-labelled hydropower.

5 'Total cost' in this case including cost for travel, hotel, allowance, transfer, travel bureau fees, admi nisration etc. for travelling, and equipment (written off in three years), telecom, studio, hosting, maintenance, and administration for audio- and videoconferencing.

6 One example is the telecom company Ericsson, which has invested in more than 800 videoconferencing equipments worldwide. Their estimated payback time of the equipment is 22 days.

7 The calculation is based on emission values on from the software tool PIANO, using data from the UN organisation International Civil Aviation Organization's (ICAO) Engine Exhaust Emissions Data Bank, Doc 9646 AN/943, (1995).

ENVIRONMENTALLY FRIENDLY ICT-PRODUCTS

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Towards more sustainable ICT-products: a snapshot of policies and first indicative evaluation results.

INTRODUCTION: THERE CAN BE NO SUSTAINABLE DEVELOPMENT WITHOUT ENVIRONMENTALLY FRIENDLY ICT-PRODUCTS[1,2]

Despite the current negative economic trend of the ICT industry, the number of Internet participants is still growing at an impressive speed. Meanwhile, most experts expect the merger of various communication and information services and the Internet. Some experts already speak of the Internet revolution. Whatever the right term, there can be no doubt, that this event will have huge social, economic and ecological impacts.

Because of the enormous potential effects, it is necessary to assess environmental impacts of this revolution. A closer examination reveals that these impacts can be divided into two very different categories. There are first significant environmental impacts that result from setting up, running and maintaining the ICT equipment that sustains the Internet. A completely different set of environmental impacts will result from the use of Internet applications.

In this paper the focus is on direct environmental impacts[3]. Since we are convinced that there can be no sustainable development without sustainable products, we will investigate steps that can be taken to reduce the environmental strain that results from production, use and disposal of ICT equipment. In order to do so, we will first present an overview of the environmental impacts. Then we will adopt the point of view of a policy maker. We will ask which policies are suitable to bring about improvement. And we will explore framework conditions that policy makers should take into account when designing policies for this sector of industry.

WHAT ARE THE DIRECT ENVIRONMENTAL IMPACTS OF ICT-PRODUCTS?

Environmental impacts can be defined as substantial or potentially substantial adverse changes in any of the physical conditions of a part of the environment, which is caused by an environmental intervention. To name but a few, such environmental interventions can be emissions into the air, the disposal of solid or liquid waste or physical interventions like noise, pressure or radiation. Parts of the environment that can be effected are the climate system (including the ozone layer), groundwater, plants, animals, soils and infinitely many others.

At first sight the distinction between environmental interventions and environmental impacts may appear insignificant. Yet the difference matters, as the following two examples illustrate: the emission of carbon dioxide is an environmental intervention whose impact is climate change. Here the scientific link between the two is sufficiently well established. There is a clear corre-

lation between the environmental intervention (the amount of emissions) and the environmental impact climate change. In the case of chemicals that are released in the environment such a link is much more difficult to establish. As the toxic effect on animals, plants or humans is dependent on the toxicity, the persistence, the concentration and its capability to react with other substances, it matters how chemicals are spread out in the environment and whether they can bio-accumulate. In table one we attempt to list the most important environmental interventions and their respective environmental impacts that can be attributed to ICT products.

Phase in life cycle / activity	Selected environmental interventions that result from the activities during the phase	Resulting environmental impacts
Material acquistion • Extraction of raw materials (oil, copper, platinum, mercury, cadmium, silicon, etc.)	Intervention in landscape and soil	Destruction of ecosystems Impact on natural ground water Loss of fertile land Change in micro climate
	Overburden becomes waste	Possibly eco-toxic effects Changes in land use and landscape
Manufacturing and sale • Production of electronic devices (e.g. Semiconductor, capacitors, printed circuit board, printed wiring assemblies, cathode ray tubes, liquid crystal displays, etc.) • Assembly of ICT products	Air emissions (fugitive emissions, e.g. HCFCs, hydrogen, silane, arsine, organice solvent vapor)	Depletion of stratospheric ozone Eco-toxic effects on flora, fauna, toxic effects on humanity
	Effluents containing, for example, acids, alkalis, metals, organic solvents	Eco-toxic effects
	Leakage from landfilling of solid wastes (e.g. scrap components, hydroxie sludge, solder dross, sludge containing heavy metals)	toxic effects, (particularly of lead and other heavy metals)
Use Phase • Usage of equipment • Production of material inputs that are required for running ICT equipment (paper, toners, batteries ...)	Emissions of ground level ozone	impact on human health
	Radiation from cathode ray tubes	No clear picture of the impact on humans
	Effluents (e.g. from paper industry) and air emissions, waste generation	Toxic and potentially toxic effects
End of life management • Waste treatment (incineration, landfills, recycling) • Inproper Waste treatment (waste export, illegal dumping)	Air emissions, particurarly from incineration (e.g brominated dioxins and furans)	Potentially toxic, toxic and highly toxic effects
	Leakage out of landfills (e.g. lead, chromium, radioactive substances, asbestos, brominated flame retardants)	Toxic effects
Throughout the entire life cycle • Energy production • Transport	Emissions into the air resulting from energy consumption and transport (GHG, NOx, SOx)	Climate change Acidification

As table 1 suggests the release of chemicals into the environment is an important environmental intervention. Clearly, due to the above-mentioned inherent problems of assessing toxic effects the impact of this intervention cannot be quantified. Yet, to our surprise there is also incomplete knowledge on the magnitude of the emissions. Obviously a quantification of the emissions would require good knowledge of the entire life cycle, particularly, of the production procedures as well as of the various ways of disposal. Even if all this information were accessible (which is not the case as particularly production in developing countries makes an assessment of environmental standards difficult), a correct quantification would remain methodologically difficult. It would require life cycle analyses for the many different substances that are contained in ICT equipment and that are being used during the production. Despite that we feel there is sufficient information to deduce that the release of chemicals is a severe problem: Currently, already four percent of the municipal waste stream in the EU are electric or electronic waste and this waste stream is still growing faster than the total amount of waste. More than ninety percent of this waste is incinerated, landfilled or recovered without special pretreatment (AEA Technology 1997, EU 2000). In Japan the broad picture is relatively similar: According to the Japanese Electronic Industry Development Association (JEIDA), the number of disposed PCs has more than doubled since 1995 (KOGA 2000). In contrast to Europe, the fraction of electronic and electric waste that is being collected and treated before disposal is expected to rise significantly as new legislation has been adopted in the first half of 2001 (Morishita 2001).

Other environmental impacts affect the climate system and the ozone layer. As explained above one may use measures for the environmental intervention (the emission of greenhouse gases (GHG) or the emission of ozone depleting substances (ODS) as approximates for the contribution to the environmental impact (climate change and destruction of the ozone layer). As concerns ODS a phase out is currently underway, mainly in response to the Montreal Protocol. Thus the ICT industry will in the short-term largely cease contributing to the destruction of the ozone layer. For GHGs the situation is different: According to Sony Corporation, the amount of 100 kg of carbon dioxide can be attributed to the production, use and disposal of one notebook (Tomita 2000)[4]. To put this into a perspective, around 100 kg of carbon dioxide are released when travelling 500 km by car. On a more general level, a study by the Wuppertal Institute revealed that slightly less than 1 percent of the German

total GHG emissions in the year 2000 can be attributed to the ICT equipment that sustains the Internet (Barthel/Lechtenböhmer/Thomas 2000). Similar studies that were carried out in the US point in the same direction (Koomey 2000). On the grounds of these findings it is safe to conclude that currently ICT products contribute relatively little towards global climate change. As the study by the Wuppertal Institute also showed, this amount may rise significantly, if no policy intervention occurs.

A last type of environmental impacts are those that result from the material acquisition. The impacts of this activity can be measured by using the concept of "ecological rucksacks" (a figure that denotes the material input that is necessary to produce a specified amount of raw material), which was developed by the Wuppertal Institute (Schmidt-Bleek 1998). This indicator rests on the assumption that the material input can be used as an approximate for the environmental impacts that result from raw material extraction. In order to obtain the ecological rucksack of one computer one would need to determine the amount of different materials that are included in a computer and multiply this with the corresponding rucksack value. Such a study, however, is extremely difficult to undertake, since, to our knowledge, there is incomplete information on the substances contained in computers. Even if this data were available, it would not suffice to compute the ecological rucksack. As the ecological rucksack heavily depends on the source - secondary copper (a rucksack of 9.66 t) vs. primary copper (a rucksack of 500 t) - a researcher would need to investigate the source of the material. Typically, electronic goods contain traces of metals with very heavy ecological rucksacks, like gold (540,000 t), platinum (320,300 t) as well as significant amounts of metals with medium ecological rucksacks like copper (primary copper 500 t), lead (15,6 t) and iron (4.66 t). Therefore, electronic goods can be suspected as being highly material intensive and thus they presumably contribute significantly to the negative environmental impacts that result from raw material extraction.

Obviously, our description is incomplete. However, it allows drawing four conclusions. Firstly and most importantly, we conclude that the production, use and disposal of ICT equipment causes significant environmental impacts, whose scale can not be properly assessed today.

Secondly, relative to other sectors the ICT industry itself currently contributes relatively little to climate change and has ceased to contribute to the destruction of the ozone layer.

Thirdly, as a preliminary result we deduce that the release of hazardous substances with potentially toxic or toxic effects either by way of aerial emissions or of solid or liquid waste is a significant environmental problem, whose impacts cannot be assessed straight away due to the inherent methodological difficulties in assessing toxic effects. Currently, there is also incomplete knowledge on the amount of substances that are released during the entire life cycle.

And lastly, it is our impression that further research is necessary to understand better the impacts that result from the material intensity of ICT products.

STRATEGIES TOWARDS MORE SUSTAINABLE ICT PRODUCTS: WHICH ROAD TO TAKE?

Eco-labels, standards for electricity consumption, bans of certain substances – in the light of the above mentioned environmental impacts the multitude of policy instruments that is already in place in Japan and Germany is hardly surprising. The Wuppertal Institute for Climate, Energy and Environment togeth-

Life phase / strategy	Activity
Material acquistion / reduce the material input	• Use more material with smaller "ecological rucksacks"
Production / towards cleaner production	• Reduce emissions and energy consumption
Production / integrate environmental features into product design	• Reduce chemical load of ICT products • Construct such that emissions and energy consumption during use are minimised • Ease end of life management by constructive measures
Use phase/ Extend use phase	• Ease upgrading • Improve service • Bring up new business models (e.g. leasing)
End of life management / Improve waste treatment	• Stop untreated disposal • Increase recycling quotas • Treat parts that contain highly toxic substances separately • Stop illegal export of electrical and electronic waste into developing countries • Collect electrical and electronic waste separately from municipal waste • Classify material

er with the Japanese Institute for Environmental Strategies (IGES) systematically screened the policy mix that is being applied in Japan and Germany (the European Union) with regard to energy efficiency, public procurement, ecolabels and return of IT products (Langrock/Ott/Takeuchi 2001). In table two we present a list of activities that could alleviate the environmental stress from ICT products.

As has been written above, governments in Japan and Germany (the European Commission) already pursue many of these activities. Currently, the most important initiative in the EU targets the collection of electric and electronic waste (EU 2000). With this directive the EU wishes to improve the end of life management of ICT industry. In Japan similar laws have already been adopted.

FRAMEWORK CONDITIONS FOR POLICY MAKING: FIRST INDICATIVE RESULTS

When preparing the above-mentioned policy dialogue we learned that as of yet there is very little knowledge on the efficacy of policies in the ICT sector. Also, policies in the ICT sector have not yet been subject to systematic evaluations. Naturally, it was behind the scope of the policy dialogue to undertake such evaluations. Nevertheless, after fruitful discussion with industry representatives from Japan and Germany we feel in a position to present some indicative results that are presented as case studies. By virtue of their origin the presented results can only be indicative. More careful and comprehensive research is needed to corroborate these findings.

CASE STUDY ENERGY EFFICIENCY STANDARDS: WHAT IS THE BEST INTERPLAY BETWEEN TECHNOLOGICAL PROGRESS AND ENVIRONMENTAL POLICY MAKING?

Among the many policy instruments that target the reduction of energy consumption of ICT products during the use phase two of them deserve further attention. There is, firstly, the USEPA energy star endorsement label for a variety of appliances (USEPA 2001). Producers of printers, monitors, scanners, photocopiers, fax machines and multifunctional devices may use the label, if their products meet the required energy efficiency standards. In the recent past some criticism has emerged that the energy star should apply tighter energy efficiency standards. Nevertheless, it is generally regarded a success story: When it was introduced eight years ago, its novel feature was to define a "sleep" mode for the above mentioned product categories and to limit the ener-

gy consumption in this "sleep" mode. More than 8 years after its introduction the "sleep" mode is a common feature of computers, printers and photocopiers. What should be noted is that due to the low environmental awareness of IT consumers the effectiveness of the instrument was not based on channelling purchasing decisions. Instead, its effectiveness can be explained by the fact that it made product designers aware of the energy saving potential.

The Government of Japan pursued a different approach, generally termed the "top runner" approach. Among many other targets the "law for energy conservation use" fixed a binding energy efficiency standard for various product categories, among them computers and photocopiers. The law targets the energy consumption in a particular mode, which is different from the "sleep" mode. The target value for the year 2005 equals the energy consumption of the most energy efficient product on the market in autumn 1998 (Arima 2000, Gamo 2000). In doing so the law will increase energy efficiency by eighty three per cent within seven years. Despite this seemingly impressive figure, the top runner approach can be regarded as only moderately successful. Why? Already in autumn 2000 a significant fraction of the computers on the market complied with the fixed energy efficiency targets (Gamo 2000). Thus, the conclusion is not too far-fetched that achievement of the targets was nothing else than business as usual.

An important lesson can be learned from these two examples: Within the ICT industry rapid technological development is a strong contributor to the achievement of environmental goals. This has two consequences. Firstly, in order to achieve environmental goals, the research and development activities of companies should be supported and channelled towards the achievement of environmental objectives. Secondly, the example exhibits the limits of legal action. Laws can only slowly be adapted to the technological development and their binding character is bound to result in relatively weak targets. The current WTO challenge of the planned EU wide ban of lead is yet another example supporting this finding. Instead of legal action, soft measures like voluntary agreements or labels may be more successful in reaching fast progress.

CASE STUDY ECO-LABELS AND GREEN PROCUREMENT: HOW TO RAISE CONSUMER AWARENESS?

In many markets eco-labels have played a significant role in channelling demand towards products that are environmentally friendly. It is thus hardly surprising that the idea is also being applied to ICT products. To name but two,

there are now computers, printers, and monitors that carry the German "blue angel" or the Japanese "eco-mark". These two labels are an interesting example of international policy co-ordination, as the Japanese eco-mark programme took over the criteria of the German blue angel programme. Thus both labels are rather similar, they are both comprehensive, covering issues as different as recyclability, energy consumption, hazardous substances and availability of prefabricated parts for maintenance. Another similarity of both labels is the award process: Producers must apply for certification and the label is awarded on condition that all required criteria are met. Last but not least the degree of public recognition is high among the citizens in Japan and Germany respectively. Nevertheless there are signs that both labels may not succeed in channelling demand. Firstly, the number of computers that were awarded the labels is relatively low, which is a sign that producers do not appreciate the label. Secondly, private IT consumers do not respond satisfactorily to the labels (Sato 2001).

In contrast to private consumption, commercial procurement typically rests on more professional decision making procedures. It is therefore interesting to look for successful measures in this market segment. According to the representatives of the workshop "International climate policy and the IT-sector", the "Environmental Data Books for Product Selection" and the "Green Purchasing Guidelines" of the Japanese GPN - a not for profit association - proved quite successful. Here the emphasis is on the dissemination of information that is relevant for green procurement and capacity building concerning environmental decision-making.

From these examples we deduce two framework conditions and their implications for policy making from these examples: Firstly, the market for ICT products is split into a segment of commercial consumers and private consumers. Whereas in the former environmental criteria do not play a role in decision making today, the latter is characterised by more professional decision making procedures that are capable of handling the complexity of environmental information. Another crucial difference is that private consumers currently rank performance above all other usual criteria like brand names, quality or support[5]. All policy instruments that are being used in order to raise consumer awareness must address this difference between the two segments. Private consumers need much simpler information than commercial consumers. Secondly, the information that is relevant in order to decide on the environmental performance of ICT products is extremely complex. This first

implies that ways must be found how to reduce the information load without losing precision. A rating system, for example, might be more appropriate than a label. Additionally, as the example of GPN showed independent agencies can play an important role in structuring and analysing the environmental information. Last but not least, in order to develop a discourse on the environmental performance of ICT products information gathering must be eased. Therefore attempts like the self-declaration sheets developed by the European association for standardising information and communication systems deserve support.

CONCLUSION AND SUMMARY

As the section on environmental impacts has shown, ICT products today are far from being environmentally friendly. Indeed, there are signs that most of the environmental impacts that result from ICT products are not properly understood and therefore not properly acknowledged by the public. This is particularly true for potentially toxic, toxic and highly toxic effects from substances that are released during production and end of life management as well as for the material input that is necessary to produce ICT products. Potentially, the growing number in ICT users might raise the energy use and thereby the climatic impact of ICT products considerably.

All these direct impacts of the ICT industry must be seen in relation to the indirect impacts that will undoubtedly result from the growing use of Internet applications. Some proponents, particularly from industry, argue that there will be enough positive environmental impacts that compensate the above mentioned negative impacts. From our point of view such reasoning is premature. As of yet, neither the direct nor the indirect environmental impacts are sufficiently understood.

Thus there is no excuse for non-action with regard to ICT products. Indeed there exist many technological innovations that can help make ICT products much less environmentally stressful. To a large extent the policy maker's task is to stimulate such innovation and make ICT producers incorporate these innovations into their products. As our case studies have shown, soft measures may be appropriate to bring about innovation in certain areas.

However, there are other fields for policy intervention where legal action is more appropriate.

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FOOTNOTES

1 ICT - Information and Communication Technologies

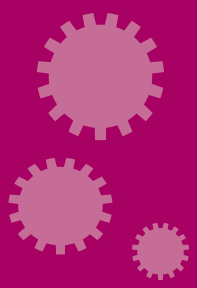
2 Most of our work is based on background material that was produced in the framework of the "Policy Dialogue between Japan and Germany to combat Climate Change" and a workshop that the Wuppertal Institute convened together with the Japanese Institute for Global Environmental Strategies (see Langrock/ Ott/Takeuchi 2001). The report is available through www.wupperinst.org/Projekte/Klima/policydialogue/index.html or as a printed version with the Wuppertal Institute.

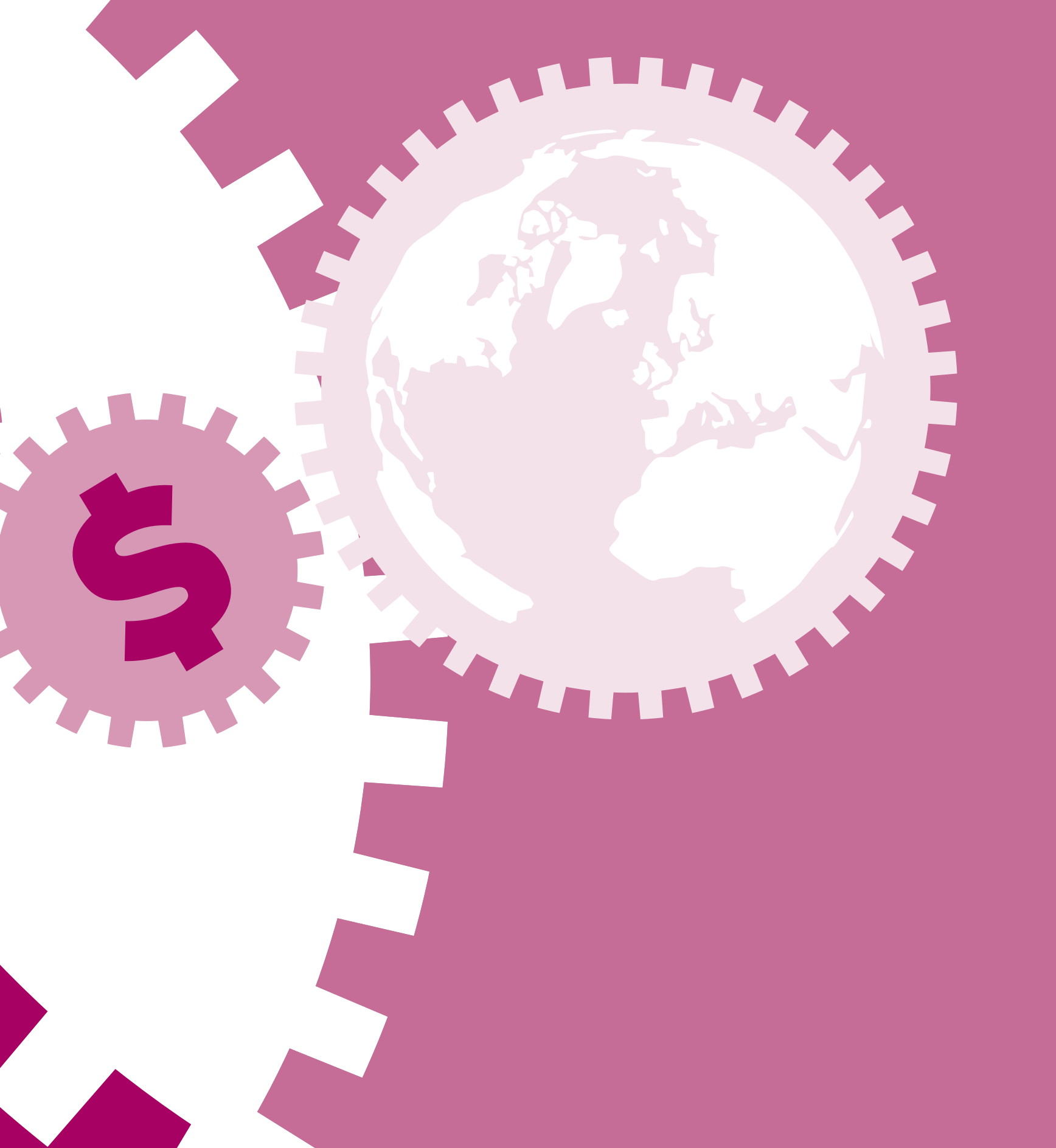
3 The Wuppertal Institute will also contribute to an assessment of the indirect environmental impacts. Currently various projects are underway in this respect.

4 In this example the use phase was assumed to last three years.

5 Currently the fraction of computers that established brands sell to private consumers is relatively low.

FACING THE POLICY CHALLENGES
RAOUL ZAMBRANO





A new technological revolution, propelled by the rapid development and deployment of Information and Communications Technologies (ICT), is transforming the global economy by changing its core dynamics. The emerging global networked economy is deepening the interdependence among countries while promoting new opportunities for developing nations to reinsert themselves in the world economy.

I. THE CONTEXT

To confront this global challenge, developing countries, working together with the international community and development partners, need to be proactive and harness these opportunities in the short-run. Otherwise, their ability to compete and participate in the global economy will be further reduced, thus exacerbating existing social and economic inequalities, and global marginalization.

The diffusion of ICT remains highly uneven both between and within nations . The so-called "digital divide", in large part a reflection of existing economic and social inequalities, is the result of the unequal access to and diffusion of ICT on a local, national, and global scale. Is it thus not a mere technological issue. Although the expansion of the market has played a critical role in fostering both access to and use of these technologies, as in the case of infrastructure and enterprise development, market forces alone will not close these gaps.

This is certainly the case for most developing nations, particularly in least develop countries (LDCs), where "market failures" are pervasive and impede the flow of new investments. Moreover, as new competitive opportunities emerge, traditional comparative advantages and niches are, at the same time, becoming obsolete or reaching the end of their cycle. For example, the terms of trade of traditional exports from developing countries such as coffee and sugar, to mention a few, have been declining for at least the last ten years - a trend that has had substantial negative impact on foreign exchange and national living standards.

The risks are indeed great, but so are the rewards. In addition to generating new mechanisms for economic growth, ICT can also serve as a critical enabler to achieve many of the development goals agreed to by world leaders at the UN Millennium Summit . Emerging empirical evidence strongly suggests that ICT has the potential to generate income opportunities and jobs, improve the delivery of and access to health and education, facilitate information sharing and knowledge creation, and increase the transparency, accountability and effectiveness of government, business and non-profits .

By making ICT an integral part of development assistance, developing countries and their partners have the opportunity of addressing the economic, social and digital divides in far more innovative and effective ways than in the past. Developing countries and the international developing agencies and institutions must take on this policy challenge to successfully harness the dig-

ital opportunities and address development issues related to poverty alleviation and democratic governance among others.

Without doubt, the use and diffusion of ICT in developing countries has taken off in the last 5 years. Back in 1995 only three nations in the African continent had access to the Internet. Today, all of them have some sort of connectivity to the global network. Perhaps a more critical revolution in developing countries has been the rapid spread of cellular/wireless technologies which have allowed millions of citizens to use a telephone for the first time and use the technology to promote their products and businesses . This certainly has overshadowed the so-called "Internet revolution" where access costs and skills required are higher. However, the upcoming convergence of these technologies will undoubtedly provide a critical boost to the faster diffusion of ICT in poor countries at affordable costs and localized use.

The bi-lateral and multi-lateral agencies and institutions has also been active in the field since the mid 90s. Although most of them were caught by surprise by the rapid evolution of ICT, today all of them are supporting the use of ICT in developing nations. This in contrast with 1995 when very few development agencies were working in ICT related initiatives. Today, it is not difficult to find multiple ICT related initiatives in any given country.

The issues at stake here are a) the apparent lack of coordination among development agencies in national and regional ICT initiatives -thus leading to some duplication and b) the lack of a comprehensive framework on the part of decision makers in developing nations to prioritize the interventions proposed by the agencies and instead promote their own in a systematic way that also addresses key development priorities.

To address several of the issues mentioned above, the international community in close collaboration with developing countries has launched a series of initiatives which are described below.

II. THE DIGITAL OPPORTUNITY TASK FORCE (DOTFORCE)

Created by the G-8 heads of state at the Kyushu-Okinawa Summit in July 2000, the dotforce brought together 43 teams from government, the private sector, non-profit organizations, and international organizations from both developed and developing countries to address the "digital divide". To facilitate its operation and provide expert input in the process, the dotforce established a Secretariat which was co-hosted by the United Nations Development Programme (UNDP) and the World Bank. By means of an open and participatory

process which included consultations with various other networks and players in the ICT field, the dotforce prepared a final report which included the Genoa Plan of Action and was submitted and endorsed by to the G-8 leaders at the Genoa Summit.

The Genoa Plan of Action has nine main action points which can be summarized as follows:

1. Help Establish and Support Developing Country and Emerging Economy National e-strategies
2. Improve connectivity, Increase Access and Lower Costs
3. Enhance Human Capacity Development, Knowledge Creation and Sharing
4. Foster Enterprise and Entrepreneurship for Sustainable Economic Development
5. Establish and Support Universal Participation in Addressing New International Policy and Technical Issues Raised by the Internet and ICT
6. Establish and Support Dedicated Initiatives for the ICT Inclusion of the Least Develop Countries
7. Promote ICT for Health Care and in Support Against HIV/AIDS and Other Infectious and Communicable Diseases
8. National and International Efforts to Support Local Content and Applications Creation
9. Prioritize ICT in G-8 and other Development Assistance Policies and Programmes and Enhance Coordination of Multilateral Initiatives

III. THE DIGITAL OPPORTUNITY INITIATIVE (DOI)

The Digital Opportunity Initiative (DOI), an innovative public partnership among the UNDP, the Markle Foundation and Accenture, was also launched at the G-8 Okinawa Summit in July 2000 to provide substantive support to the work of the dotforce. The DOI set up to fill three specific goals: 1) provide a conceptual framework for ICT for Development; 2) promote national and global awareness of the role of ICT in the development process; and 3) based on 1) and 2) above, launch "exemplar initiatives" in selected developing nations as proof of concept and replicability

The conceptual framework is presented in the final report of the DOI entitled Creating a Development Dynamic which was submitted to both the dotforce and the G-8 leaders before the Genoa Summit. The objective of the DOI report is to provide a framework that will enable developing countries, com-

munities, and supporting organizations leverage the benefits of ICT to further sustainable development.

Today, strong skepticism still persists in many quarters on the relevance of ICT in the development process. The issue here has two different angles: on the one hand, the "either/or" argument where a few development organizations and developing countries perceive the investment on ICT as an alternative and not as a complement to ongoing development funding. This view was reinforced by the apparent systematic failure of "first generation ICT" for Development projects and programmes in several nations -particularly true for telecenter and distance learning efforts. On the other hand, and also based on the later, the lack of substantial empirical evidence that demonstrated that ICT, when properly use and applied, can have a positive impact in helping to achieve specific development goals set by the various sector and/or countries.

In this context, Creating a Development Dynamic reviewed more that three hundred ICT for Development initiatives and gathered the relevant empirical evidence that showed that ICT, under certain conditions, does have a positive impact in facilitating new economic opportunities, promoting a sustainable environment, delivering improved health and education to the people, and fostering democratic governance by empowering citizens and organizations, and rationalizing government functions with modern technologies and processes.

This is certainly not an automatic process and care should be given to design and implementation details. For starters, the end goal of any of these initiatives should not be technological. On the contrary, initiatives should have clear development objectives and be demand-driven, owned by its beneficiaries. Furthermore, initiatives need to have a built-in sustainable mechanisms and not die once donor funding or related is exhausted. The creation of partnerships among the various players or sectors involved in any of the initiatives should facilitate this process by fostering a more "holistic" approach to the programmes or projects.

Perhaps less know to the public is the fact that indeed a selected group of developing countries have already embarked in establishing and implementing national ICT for development strategies. Although this process certainly started before the "Internet revolution" in the early 1990s -a process pioneered by Brazil, India and Korea, the country examples studied in the DOI report provide new and critical material for making the case for ICT as an enabler for development. Based on country studies of Brazil, Costa Rica, Estonia, India, Malaysia, South Africa and Tanzania, the report suggests a typology for nation-

al ICT strategies which can be used in different contexts.

From the early 1980s, a few developing countries began adopting national ICT policies, particularly to promote the development of a national ICT sector. This process was propelled, to a large extent, by the advent of the personal computer and increasing demand for related hardware and software applications. The emergence of the global network economy in the 1990s, fueled by the digitalization of telecommunications and later on by the rapid expansion of the Internet, offered new opportunities for a wider variety and number of developing countries to adopt national ICT policy frameworks.

But, while the strategies pursued by each country have unique features, the role assigned to ICT can be broadly characterized as follows:

- ICT as a production sector which involves policies focusing on the development and/or strengthening of ICT-related industries such as computer hardware, software, telecommunications equipment and ICT-enabled services. This can be accomplished through either a) an export-based focus (Costa Rica) or b) a national capacity focus (Brazil)
- ICT as enabler of socio-economic development which involves the adoption of holistic, cross-sector policies and strategies which aim to harness the uniqueness of ICT to accelerate a wider development process. This in turn can be accomplished through a) a global positioning focus (Malaysia) or b) a development goals focus (Estonia)

The lessons learned from the various country case studies and the three hundred or so ICT for development initiatives reviewed by the DOI point to five important interrelated areas for strategic intervention at both the policy and implementation levels: policy, infrastructure, enterprise, human capacity, and content and applications. Each of these areas or components, taken in isolation, are well know to ICT for development experts. However, by emphasizing the need to take a comprehensive or "holistic" approach, the DOI suggests that such interventions can create a "development dynamic" by leveraging the synergies and complementarities among the components and triggering 2multiplier" and "network" effects across the various sectors.

It should be clear, by the same token, that the development dynamic framework does not suggest that such a dynamic can only be ignited if action is taken in all five areas at once. While acting on any of the components can produce important results, measured and/or strategic interventions taken across sever-

al component areas can have a larger impact than those achieved by a single area focus which, in turn, are more likely to fail. But the key premise here is the policy framework which must define the national priorities and the specific role for any type of intervention at the implementation level.

In any event, the interaction of the various components does not occur in a vacuum. Once again, the evidence from the various ICT for development strategies studied by the DOI strongly suggests that, in order to reap the benefits f ICT for development, it is necessary to involve the full range of actors in the public and private sector in a process that is inclusive, open and participatory - the need for strategic compacts. The key element is the involvement of all sectors not only in the design of strategies, but also, and perhaps more importantly, in their implementation in such a way that each has specific roles and responsibilities.

Strategic partnerships are required to aggregate the capabilities and resources to address the pervasive market failures in developing countries and to create win-win situations for the various sectors and stakeholders involved. Neither the government nor the private or non-profit sectors alone can achieve this objective -each is dependent on the cooperation of others to accomplish its goals and further enhance sustainable development processes.

The DOI framework is currently being employed by countries such as Azerbaijan, Bolivia, Mauritania, Uzbekistan, and Nicaragua among others to develop national ICT for development strategies.

During the first week of February 2002, UNDP and the Markle Foundation launched the Global Digital Opportunity Initiative (GDOI) which follows on the DOI framework and aims at providing direct support to a selected groups of developing countries in the design AND implementation of national ICT for Development Strategies. The GDOI also includes an international partners group from the private and public sectors (SUN, HP, CISCO, ITU, UNECA, etc.) who will be providing resources for country programmes. The GDOI is initially planning to work in Bolivia, Tanzania and Mozambique.

IV. THE UN ICT TASK FORCE

In March 2001, the Economic and Social Council (ECOSOC) requested the UN Secretary-General to establish an Information and Communication Technologies (ICT) Task Force. The Task Force is supported by the Heads of State and Government of all UN Member States who endorsed the ECOSOC Ministerial Declaration at the Millennium Summit in September 2000 . This initia-

tive is intended to lend a truly global dimension to the multitude of efforts to bridge the global "digital divide", promote digital opportunities and thus put ICT at the service of development for all.

The objective of the Task Force is to provide overall leadership to the United Nations role in helping to formulate strategies for the development of ICT and putting those technologies at the service of development. In addition, and, on the basis of consultations with all stakeholders and Member States, the Task Force aims at forging a strategic partnership between the United Nations system, private industry and financing trusts and foundations, donors, programme countries and other relevant stakeholders.

In similar fashion to the dotforce, the UN ICT Task Force comprises representatives from all sectors of society, including governments, private and non-profit sector of both developed and developing countries. The Task Force has thirty seven (37) members distributed as follows: 18 from government, 8 from the private sector, 4 from the non-profit sector, and 6 from multilateral organizations. The president from ECOSOC is an ex-oficio member of the Task Force.

The Task Force is expected to meet twice a year. A small secretariat will be created to facilitate the running of the Task Force and provide substantive and administrative support.

One of the goals of the UN Task Force is to complement the efforts initiated by the G-8 dotforce - rather than compete or duplicate. This is indeed reflected in the current draft action plan of the UN ICT Task Force which has essentially adopted the nine action points from the Genoa Plan of Action. In addition to these, the Task Force will also:

1. Launch a Global Leaders Awareness Programme which will also include non-profit and civil society organizations
2. Establish the Task Force Website and Portal based on Open Source Software and accessible for low bandwidth users
3. Promote Stakeholders Networks and Carry out Stakeholder Campaigns at the global, regional and local levels
4. Develop a Media and Communications Strategy
5. Foster Resource Mobilization to Finance the various Action Items

The UN ICT Task Force was officially launched on 20 November 2001 and is now planning to meet once every quarter. It has formed six working groups as follows: ICT Governance, National and Regional e-strategies, Capacity Building

(including health), Resource Mobilization, Low cost access and Connectivity, and Business and Enterprise. These groups are working hand in hand with their equivalents from the dotforce. In addition, the UN ICT taskforce has set up regional networks of expertise in Africa, the Arab States, Asia and Latin America.

V. UNDP'S ICT FOR DEVELOPMENT STRATEGY

Since 1993, UNDP has been directly involved in promoting ICT for development programmes and initiatives. It has developed substantial on the ground expertise and knowledge through global initiatives such as its pioneering Sustainable Development Networking Programme (SDNP) , the Small Islands Developing States Network (SIDSNet), and the Cisco-UNDP Network Academies programme for 24 LDCs; regional initiatives such as the Asia Pacific Development Information Programme (APDIP) , and the Internet Initiative for Africa (IIA); and national programmes such as Ukraine's FreeNet, Jordan's Community Access Centers and Schoolnet initiatives in Cameroon and Palestine, to mention a few. Through these initiatives UNDP has helped deploy the first Internet nodes in more than 45 developing countries, trained more than 25,000 organizations and institutions, and promote local content dissemination and networking among many civil society organizations.

Based on this extensive work, UNDP's Agenda for Action 2000-2001 has explicitly recognized the key role that ICT can play in the fight against global poverty and effectively addressing the various international development targets. ICT for development has in fact become one of the six main priority areas for UNDP intervention at the country level.

As a cross-cutting issue, ICT has critical relevance and impact on UNDP's thematic areas such as democratic governance, poverty alleviation and the environment. The integration of ICT into all these areas is critical for developing countries to harness the full potential that these technologies can have in promoting targeted development goals and create new synergies and partnerships to increase the effectiveness in addressing economy inequality and social exclusion.

Based on this and on its involvement in the various global forums dealing with ICT for development - such as the dotforce, the Digital Opportunity Initiative and the UN ICT Task Force, UNDP has developed a new ICT for Development strategy that primarily focuses on upstream policy advice that complements and helps realign the current and planned projects and initiatives at the country level to the new policy challenges posed by the emerging global networked economy.

The new strategy places at is core the building of new and innovative partnerships at both the global and local levels, involving in particular the private and non-profit/NGO sectors. Mainstreaming ICT into the various development areas and explicitly addressing the pervasive market failures in the poorer nations requires such an approach as it is clear from the current evidence that no one single player alone will be able to tackle the issues in an effective and expedite fashion.

The DOI is one example of such type of partnerships. In addition, UNDP has also launched the Global Network Readiness and Resource Initiative (GNRRI), a public-private partnership with the Markle Foundation, designed to offer country-level assistance involving key international ICT experts for the development of comprehensive national e-strategies and related e-assessments. A virtual network of experts and resources will be built to support this and other related initiatives.

In this context, UNDP has identified five key areas for interventions at the national level regarding ICT for Development:

1. Design National ICT for Development Strategies (e-strategies)
2. Strategy Implementation and Capacity Development (e-Initiatives)
3. ICT for Democratic Governance (e-governance)
4. Support to Bottom-up Initiatives through Digital Grants (e-grants)
5. Promotion of National Awareness and Launching of Stakeholder Campaigns

To complement these efforts, UNDP will also provide support to regional and global initiatives to promote and enhance North-South and South-South cooperation and Networking. A dedicated ICT for Development Trust Fund has been created by UNDP to leverage resources in support of these key areas.

VI. CONCLUSION

Much is indeed happening. We have seen -and contributed to- the formation of new global partnerships such as the dotforce and the UN ICT Task Force. In addition, substantial efforts have been launched to produce a comprehensive framework that addresses the critical issues of ICT for development and furnish decision makers in both developed and developing nations with a critical tool to advance global and national development objectives. This however does not imply that we have an easy road ahead. Critical challenges remain and

need to be addressed at various levels.

The current global economic slowdown, triggered in part by the "dotcom" crash, is certainly providing new ammunition for those who remain skeptical about the role that ICT can play in promoting sustainable human development. Moreover, the incentives of investing in developing nations are now less attractive. For the poorer countries where market failures are pervasive this will probably not have a large negative impact.

From one vantage point, the current economic recession can indeed be an opportunity to further strengthen the existing global partnerships, design new cooperation and coordination mechanisms among the various national, regional and global players, refine the current conceptual frameworks, create new analytical tools and implementation mechanisms, and develop innovative funding mechanisms and partnerships.

This will undoubtedly benefit ICT for development as the fulfillment of traditional development objectives can in effect be implemented at lower costs and on a wider scale through the use of state of the art technologies that could help poor nations leap-frog well into the 21st century. ICT for Development is not a panacea but it does provide unique opportunities -digital opportunities for e-development- that need to be harnessed immediately through pro-active policies at both the local and global levels. ■

FOOTNOTES

1 On average, industrialized countries have roughly 3 users per Internet hosts whereas developing countries have over 100 for every Internet server in their countries -with rates for poorer countries being 1,000 to 1 or more. See for example http://www.telcordia.com/newsroom/press-releases/01052001.html . Although Internet growth rates are higher in developing countries, diffusion to large portions of national users remains limited and face the limits imposed by small markets and low effective demand.

2 United Nations Millennium Declaration, 2000, http://www.un.org/millennium

3 Mansell, R. and When, U (eds.), Knowledge Societies: Information Technologies for Sustainable Development, 1998, http://www.susx.ac.uk/spru/ink/knowledge.html; ILO, World Employment Report 2001: Life at Work in the Information Economy, 2001; Accenture, Markle and UNDP, Creating a Developing Dynamic, 2001, http://www.opt-init.org .

4 Recent estimates indicate that in many African nations and LDCs cell phone penetration has already surpassed fixed phone use. In addition, the ration of cell phone users to Internet users is, in a few countries 10 to 1.

5 http://www.dotforce.org/members/DOT_Force_membership.doc for full list of members.

6 http://www.dotforce.org/reports/

7 http://www.opt-init.org/framework.html

8 http://gdoi.org.

9 http://srch0.un.org:80/documents/ecosoc/docs/2000/e2000-l9.pdf

10 http://www.unicttaskforce.org

11 http://www.sdnp.undp.org

12 http://www.sidsnet.org

13 http://www.cisco.com/edu/ldci

14 http://www.apdip.org

TECHNOLOGY LEAPFROGGING AND THE DIGITAL DIVIDE

ANDERS WIJKMAN AND MONA AFIFI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The past two decades have witnessed a revolution in terms of technology developments. Information technology, the Internet, genetic engineering, nanotechnologies, new energy technologies – innovations that provide humanity with fascinating opportunities for new products and services, improved health and medicine, radically different ways of communication, enhanced productivity as well as more efficient use of energy and materials.

Take the profound impact that ICT has had on society and the way it has changed the production of goods and services, trade and distribution, research, education, information, media etc. ICT is not just another sector of economic development, nor can it simply be looked upon as a set of tools. Instead, ICT permeates every aspect of today's societal activity. Ironically, the very factors that have phenomenally improved productivity by intelligent use of the technology, also risk driving the poor to the periphery, thus creating barriers within and between societies, and could lead to social unrest and tension.

Countries and people lacking capacity for ICT will be marginalized in the new economy. New trade barriers will be erected. Moreover, without access to ICT, countries will not be able to benefit from the many innovative ways of addressing poverty and basic needs that these technologies offer.

A WIDENING GAP

One reason why the information gap is widening is that the potential of ICT in social and economic development has not been fully understood. There are still too many people in key positions in governments and aid agencies who seem to believe that only when basic needs are met does technology have a role to play. If they were right most of the poor would have to wait forever.

The debate must move beyond choosing between ICT and other development needs such as health and education. The issue is not about a trade-off between one or the other, but an understanding that these must go hand in hand. However, technology alone is not enough. Technology must be applied within its social context and that, in many countries, is providing a real challenge.

One thing is clear. The new technologies, notably ICT, will bring about major transformations in society. The structural logic of the information society will be vastly different from that of the industrial society. One eminent scholar, who has given a lot of thought to the implications of the ICT revolution, is Professor Harlan Cleveland. Here is how he perceives the future: "Information – symbols, not things – will be playing the lead role in world history that physical labour, stone, bronze, land, minerals, metals and energy once played. We will have to burn into our consciousness how very different information is from all its predecessors as civilization's dominant resource."
In his speech to the American Association for History and Computing (April 2000, Baylor University, Texas) Cleveland continues: "Information expands as it's used – no "limits to growth" around here. It is ready transportable, at close to the speed of light. Information leaks so easily that it is much harder to

hide and to hoard than tangible resources were. The spread of knowledge empowers the many, by eroding the influence that once empowered the few who were "in the know". Information cannot be owned, only its delivery service can. And giving or selling information don't give rise to "exchange" transactions; they are acts of sharing."

If Cleveland is right, we are at the doorstep of a democratic revolution. In the industrial era, poverty was explained and justified by shortages of things. In the coming years, physical resources will still be important, but their role in wealth creation will gradually be overtaken by information. And since each baby is born with a brain, there ought to be radically different prerequisites for development and progress at the level of the individual, also in the poor regions of the world. But there is a catch: whether or not the information revolution is really going to lead to greater fairness depends to what extent the poor will have access, not only to the modern information technologies, but also to education. If such access is not provided, the expected fairness revolution will be turned into its opposite.

In February 2001, well above 400 million people worldwide were users of the Internet. This represents phenomenal growth, given that the Internet is less than three thousand days old. But the spread of Internet use is very uneven. The vast majority of Internet users are found in OECD countries. There are more hosts in Manhattan than in continental Africa; more hosts in Finland than in Latin America and the Caribbean; and notwithstanding the remarkable progress in the application of ICT in India, most of its villages still lack a working telephone.

To bridge the digital divide is both a moral and a social imperative. If we do not succeed, entire regions and hundreds of millions of people will be left behind. The consequences in terms of poverty and deprivation will be devastating.

LATE-COMERS BENEFIT FROM LEAPFROGGING

But there is another, equally compelling argument for developing countries to embrace the new technologies. By investing in cutting-edge technology, through leapfrogging, they will be able to bypass certain stages of development. The benefits can be financial, social, as well as environmental. As "late-comers", developing countries can be better placed to take advantage of the newest technology developments, not the least in ICT, since they are not hindered by the previous investments in obsolete technology. Since prices come down very quickly in the area of ICT, investments in a telecommunication

infrastructure today may cost just a fourth or a fifth compared to what was the case a few years ago.

The environmental benefits would be significant, since leapfrogging would make it possible for developing countries to avoid repeating some of the mistakes of industrialized countries. Take energy. Worldwide total energy production-related investments for 2000 to 2030 are estimated at between US 12 and US 17 trillion dollars (IIASA-WEC scenarios, World Energy Assessment 2000). The majority of these investments will be made in developing countries. Presently, most of them will favour fossil fuels, primarily coal. If this trend continues, the resulting emissions in terms of carbon will be disastrous. And these emissions will negatively affect people all over the world.

New systems of energy supply and consumption are badly needed. Less polluting and more efficient energy technologies are available, but normally at a higher investment cost than conventional fuels. The challenge is at least twofold: i) to help build the necessary capacity in terms of institutions and skills in developing countries to enable them to adapt and expand on new discoveries and make them applicable to their specific needs, and ii) to provide investors with the right kind of incentives to make investing in alternative energy solutions attractive. Only if these preconditions are fulfilled will leapfrogging be possible.

Investing in clean energy and transport are the most obvious examples of how the natural environment in developing countries could benefit from technology leap-frogging. But the opportunities do not stop there. The ICT revolution by itself offers fascinating possibilities for enhancing energy and resource efficiency and reducing pollution. When society becomes more digital, the possibilities for major structural change and efficiency gains multiply. New avenues open up. Concepts such as de-materialisation, tele-working, tele-conferencing, distance education, the flexible office, e-Commerce all promise great leaps forward in terms of enhanced resource efficiency.

Environmentally sound technologies (ESTs) often depend on sophisticated measuring devices, data transmission networks and automatic data processing equipment. This can be provided by ICT, thus bringing about more efficient production processes as well as greatly enhanced product performance. Moreover, with advanced communications many conventional products will be transformed into services. A newspaper becomes an on-line news service; an instruction manual becomes an interactive technical advice service; cinema film re-production becomes a “video-on-demand” service in the home, etc.

It appears obvious to us that a high-tech economy based on knowledge, skills and innovation ought to be a cleaner, greener economy. But few attempts have been made to assess specifically to what extent the digital revolution and the sustainable development agenda complement each other. In some areas developments so far have been disappointing. For instance, as long as e-Commerce is a marginal phenomenon in society, demand for transportation seems to increase, not the opposite. When more and more people will shop on the Net, things will change. The main reason is economics. When volumes increase it will be good business to organize transport and logistics in the most efficient way. As a result the environment will benefit.

The reader may find that most of what ICT can offer in terms of enhanced energy and resource efficiency are relevant examples only in the context of OECD countries. Activities such as telework, e-Commerce, on-line services were pioneered in the US, Japan and Europe. But there is no reason why such activities should not start penetrating countries of the South as well. In fact, they already have. Many people do not realize that China is the single biggest market for mobile phones in the world today. As the volume of foreign direct investments in developing countries has multiplied in recent years, the result will be an increased transfer of high-tech from OECD countries to developing countries. True, private investments in the South are concentrated to a limited number of countries. The challenge is to include more countries in this process, and to focus specifically on applications that would promote sustainable development.

GREEN TECHNOLOGY LEAPFROGGING

Traditionally it was accepted that economic growth, as measured by GDP, was inevitably linked to growing demand for raw materials and energy as well as the negative consequences of pollution. If such linkages were to last long into the future the overall consequences for mankind would be disastrous. There are already clear signs that pollution levels are exceeding the absorption capacity of the global eco-system. Climate change is the most obvious example but there are others. Parallel to excessive pollution levels, the pressures on forests, farmland, fresh water resources and fisheries are mounting.

Efforts to try to de-link GDP growth and demand for energy and materials have therefore become a priority for policymakers in several OECD countries. The achievements are still limited, but there are signs of progress. For instance, the energy intensity of OECD countries has been reduced in the

recent past. This is the result of a shift towards more energy-efficient technologies and less energy-intensive materials. Scientists claim that this trend will continue, as a gradual saturation of traditional consumer goods will take place. One obvious reason is the move into the information economy. In such an economy an increasing part of transactions will be immaterial. Many products will be turned into services, which depend less on energy and material throughput.

Long-term studies of energy-intensity in several countries indicate that economies use more energy per unit of output during the early phases of development, reach a peak, and then start to decrease. Liberalization and information technologies should allow knowledge to be transferred more easily, enabling emerging economies to climb the so-called energy and technology ladders more quickly. This means that latecomers ought to be able to avoid the peak in energy demand by benefiting from more modern methods of manufacturing and more efficient energy technologies. However, there are many barriers to overcome for such change to happen. Studies do confirm that energy intensity is on the increase in most developing countries, not the opposite. The only exception is China, where deliberate efforts are being made to use both energy and materials more efficiently (Goldemberg, Leapfrogging strategies for developing countries).

In order for the necessary transformation to more efficient and environmentally sound technologies to happen in developing countries, several barriers to change have to be tackled. Most important is to address the capacity needs. While much knowledge for improved problem-solving is now available in many scientific and engineering institutions around the world, very little of that know-how is geared specifically to addressing development and environment needs in developing countries. Most of these countries lack the scientific institutions and infrastructure to adapt and expand on new knowledge and discoveries in order to make them applicable to their local needs.

Public planning and regulatory activity is crucial to the dissemination of most ESTs. We are dealing with capital-intensive infrastructure, which is meant to provide a public service at an affordable price. In most countries energy distribution, public transport, waste management etc. are considered to be public services. Increasingly, public authorities are choosing to delegate the operation and management of public services to the private sector. If and when this happens, it is crucial that the necessary regulatory framework is in place to guarantee environmental quality.

To create an adequate legislative and regulatory framework for the protection of the environment is a difficult process in any country. This is particularly true for most developing countries, where government structures are weak. Governments need to implement fiscal and regulatory policies that encourage innovation and provide direct incentives to companies that develop or disseminate technologies that contribute to sustainable development. Fiscal incentives should also be used to stimulate businesses and households to purchase such technologies. Parallel to that, subsidies in support of fossil fuels and other technologies that are harmful to the environment should be dismantled. The next step would be for governments to apply the Polluter Pays Principle, i.e. to make sure that environmental externalities are reflected in market prices. This represents a real challenge in OECD countries, and even more so in developing countries, but it has to happen.

As already stressed, the strengthening of institutional and human capacities is a primary prerequisite for ESTs to become a priority in the development process of developing countries. The same is true for most development co-operation agencies. In a recent study on "Technology co-operation in the field of environmentally sound technologies" to the European Parliament by IED (Innovation Energie Dévelopment, 2001) the authors conclude that "a review of organisational structures and portfolios of bilateral and multilateral co-operation agencies and banks shows that there are grossly insufficient human capacities in the areas of energy co-operation. If ESTs are to become a priority of development co-operation, the institutions of international co-operation must first and foremost be given the means to understand the issues and to formulate and manage projects".

Until recently, science and technology was more or less absent from the sustainable development debate. More recently a change can be discerned. The Human Development Report 2001 "Making New Technologies Work for Human Development" is one example. The report emphasizes the crucial relationship that exists between science, knowledge and human capacity in addressing issues of sustainable development.

One important message from the Human Development Report is that technological progress and knowledge applications are key drivers of economic growth. The logical conclusion is that support to science and technology ought to become a top priority for development co-operation.

The little attention given by ODA, so far, to science and technology also means that support to ESTs have been largely neglected. The only mechanism

at international level worth mentioning in this context is the Global Environment Facility (GEF). The GEF has given support to capacity building in the field of sustainable energy and to renewable energy pilot projects. But compared to the total investments in energy production in developing countries, the resources of the GEF have been woefully inadequate.

One possible source of finance, that ought to be utilised in support of investments in ESTs, is the export-credit agencies (ECAs) of OECD countries. However, until very recently these agencies were paying no attention at all to the environmental aspects of their lending. On the contrary, during the period of 1994-99, it is estimated that more than 100 billion of US dollars were being mobilised through the ECAs in support of investments in carbon-based technologies. Just imagine if the same attention had been given instead to investments in energy efficiency and renewables.

Efforts have been made within the climate convention to establish new sources of finance to assist developing countries both in climate adaptation and investments in clean technologies. It is too early today to judge to what extent the new mechanisms will make a difference.

THE DIGITAL DIVIDE CAN BE BRIDGED

Presently, we experience the technologies of the information and communication revolution at the cutting edge of progress. Their application also offers momentous opportunities for development. They present developing countries with real opportunities in helping to bridge the economic and prosperity gaps between them and developed countries.

Today, village computer centers in developing countries help farmers check the going prices for their produce in the city, thus avoiding arbitrary markups by middlemen. The same centers provide distance education and learning and help improve health services. Today, rural artists and craftsmen in remote villages can reach a global market with their products, thanks to non-profit Internet sites.

Yet, at the same time, billions of people still live untouched by the digital revolution. Only about 7% of the world's population can claim connectivity, and the greater majority of these are living in the developed countries. As a result, the income gap between the developed and developing countries is being further aggravated by the digital divide. This holds ominous consequences for the developing countries in terms of increased poverty, unemployment and under-development. This is not the result of some conspiracy

against the poor. Rather it is the result of a development where access to information and knowledge are becoming the most important factors of production. Those with access to information and technology naturally benefit in this situation; those without access become further marginalized.

However, the situation should not be regarded as hopeless. Even if the information revolution so far is widening the gap between the rich and the poor, this need not become a pattern for the future. There are many tangible examples from around the world of how ICTs are being deployed to address important development goals. Evidence shows that ICT initiatives need not be confined to countries with high per capita incomes, well-developed infrastructures and high levels of venture capital in order to succeed. Indeed, remarkable progress is evident where some of these elements have been lacking. The experiences of a few countries, including both developing countries and transition economies, have demonstrated that bold actions in bringing their countries into the digital age have paid off and brought tangible results in economic, social and political terms. Prominent examples are *Estonia, Mauritius* and *Costa Rica*.

Costa Rica attributes much of its recent economic growth to the widespread adaptation of ICT. The focus has been on the educational sector. Computer laboratories were installed in all of the country's public high schools, thereby reaching 50 per cent of the children enrolled in public schools. "Smart cards" have been introduced nation-wide in public administration, transportation, public telephones and health services. Parallel to that a variety of efforts have been made to use ICT to help integrate isolated rural populations, notably by introducing multi-purpose/multimedia mobile units that can be taken to any rural community and provide a variety of functions (Internet access, ICT training, e-mail facilities etc.).

Estonia had a very low level of ICT at independence in 1991. Today, the country has one of the highest degrees of connectivity in Europe. All schools have been connected to the Internet; more than 80 per cent of bank transfers are made over the Internet; "smart cards" were introduced for interaction with government services etc. The per capita income has risen from US 600 in 1991 to more than US 5000 in 2000, a development largely made possible by the very proactive ICT strategy pursued.

Mauritius adopted a National Information Technology Strategy Plan early on. The primary objectives were to bring Government closer to the people through e-Government, to use ICT to enhance the education system and the service

sector, and to improve the efficiency of the public sector. A special Ministry was created to promote ICT applications in different sectors of the Mauritian society. As a result of the dedicated efforts Mauritius has attracted a great number of small and medium-sized ICT-based companies.

The great majority of developing countries, however, have done little in terms of a coherent strategy to embrace the ICT revolution. This does not mean that nothing is happening in all these countries in terms of ICT for development. There are numerous initiatives, mainly among NGOs, that hopefully will help raise awareness and demonstrate, to governments as well as aid agencies, the great opportunities that the new technologies offer both for accelerating economic development and, more specifically, to help advance the human development agenda.

ICT MAKES A DIFFERENCE AT GRASSROOTS LEVEL

Among the many examples of initiatives at the grassroots level, the following may provide an illustration of the significance of ICT in addressing basic human needs:

Technology Community Centres Access in Egypt (TACCs)

The overall aim of the TACC pilot project – established with support of UNDP - was to "provide rural and remote communities with public access to information technology, especially the Internet, and with the training to utilize it effectively". The project's ultimate goal was to demonstrate how information technologies could contribute to "the empowerment of community members" and how such technologies could be used "for a variety of applications benefiting sustainable human development". A pilot, consisting of several cyber cafes, was established in Sharkeya.

The pilot has succeeded beyond the most optimistic expectations. Some 6,000 persons have received IT training with a view to supporting various development activities at the community level. To date, TACC staff – national and international (mainly United Nations ´Volunteers) – have developed and posted over 1,000 web pages, most of them in Arabic. The websites provide information on ICT training, health, agriculture, e-commerce, the culture and history of Egypt, recreational activities, etc.

In light of the success in Sharkeya, the government of Egypt recently decided to establish similar centers in all of the country's 26 Governorates. The TACC concept is also being replicated in Jordan.

Village Knowledge Centres

The experimental telecentre project in South India was initiated in 1998 by the M.S. Swaminathan Research Foundation. Four centers have become operational, located in villages with illiteracy rates above 50%. The project is based on the understanding that networked information requires "mediation" by professionals if it is to be accessible to poor rural villagers. The information compiled and collected for the project is primarily based on requests by the village end-users. This information – which includes items like commodity prices, weather forecasts, daily news, government information, methods of dealing with crop diseases, fishing methods etc. - is translated into Tamil, packaged into audio files and distributed via the Internet to the four Village Knowledge Centres. The local centers broadcast the audio files over loudspeakers to the illiterate villagers. Evidence suggests that the villagers benefit significantly from the information in regard to making decisions affecting their lives and well-being.

Grameen Village Pay Phones

Women members of Grameen Bank are offered micro-credit loans to purchase cellular phones, which are subsequently rented out to village farmers and other community members. As of July 2001 phones had been placed in more than 1.000 villages. Phone services in rural areas are highly valued in Bangladesh and have rapidly increased incomes and savings among phone owners. The village phones allow family members to stay in touch and communicate with family members abroad about financial matters like remittances. Local farmers use the phones to have access to market information, weather reports and pest alerts. The phone services have also contributed to improvements in disaster response, crime rates and livestock mortality through better access to public services.

Reproductive health information on-line

The association of Uganda Women Medical Doctors was started in 1987 with a mission of improving and facilitating the promotion and protection of health to women, young people and children in Uganda. They decided in the spring of 2000 to try to make use of Internet in their work. The aim of the project was to disseminate information on reproductive health electronically to other women NGOs. Medical doctors in Kampala download the necessary information, repackage it and send it online to the participating NGOs. Feedback from the

NGOs is also received via the Internet, including specific questions asked by clients at health clinics. Already after a few months the project had demonstrated increased awareness among rural women of reproductive health issues.

TARAhaat (Technology and Action for Rural Advancement)

A fascinating pilot project in the field of ICT for development is currently being developed by Development Alternatives, Delhi. The main objective of TARAhaat– the Internet Portal connecting rural India to the global village - is to use the power of ICT to bring knowledge, services and products to the villages in India. Starting in Punjab and Uttar Pradesh, the plan is to establish tens of thousands of Internet and computer enabled business centers all over the sub-continent in the years to come.

The portal offers email, e-Commerce, education, entertainment, access to e-Government facilities, etc. Eventually TARAhaat plans to bring the village manufacturers in contact with buyers and designers the world over. Access to the portal is being provided by franchised cyber kiosks, which are operated by local village entrepreneurs. Satellite communication, wireless broadband and local power generation will be used where there is no electricity or phone.
Overall few donor-funded ICT projects in developing countries have proven to be self-sustaining once external assistance has run out. The encouraging thing about TARAhaat is that its pilots shows signs of being able to stand on their own feet only after six to twelve months of operation. This means that the revenues generated by these kiosks are sufficiently large to provide a surplus. What this demonstrates is that even in the poorest of villages there is significant demand for communication and ICT services.

Masai pastoralists on the Web

In Tanzania, Masai pastoralists living in the Ngorongoro have used the Internet to voice their opposition to Government conservation management policy that threatened their land and their livelihood. A member of the Masai community came up with the idea of putting his people on the World Wide Web after he made a video about the critique of the pastoralists on the Governments management plan for their land. He put clips of “real people” from the video to the website and managed to mobilize support for the cause of the pastoralists around the world. In addition to obliging the Tanzanian Government to listen to the voices of the local communities, the Masai say that their web site makes them feel less isolated: they feel part of a “bigger world”.

INTERNATIONAL COMMUNITY FINALLY RESPONDING

ICT has been extremely beneficial for those nations that have used it with determination and enthusiasm as part of their national development strategies. Many individual examples from developing countries also demonstrate how ICT, appropriately applied, can help address basic social needs. In spite of this, the international donor community has been slow in addressing the digital divide. There has been much talk but little action. At the receiving end, there has also been a lot of resistance. Quite a number of developing country governments have been slow to open up to ICT, either for political or cultural reasons, or simply because they do not believe that ICT can be of importance to the development of their countries.

If the general trend among donors can be characterized as passivity, a few institutions have understood the importance of ICT for development. Canadian IDRC has been a strong promoter of ICT capacity building for over a decade. Swedish SAREC also played a supporting role in the early years. The main focus for IDRC and SAREC has been to build capacity for ICT at universities and scientific institutions in the South. IDRC has also been a pioneer in other areas, using ICT in natural resources management, the provision of health care, etc.

ICT for development became a central issue for the World Bank in the mid 1990´s. Jim Wolfensohn had joined the bank as president and soon declared that he wanted to turn the bank into a "knowledge bank." The bank has since launched several good initiatives, like InfoDev and Gateway. Support to ICT capacity building, however, is still far from being among the Bank's priorities in terms of funding.

The UN system has been a disappointment, mainly because of shrinking funding support for UN agencies in general. There are two exceptions, the ITU and UNDP. The ITU has done its part in terms of awareness-raising activities, but – true to its mandate - focusing mainly on the need for reform and liberalization of the telecommunication sector. UNDP was a pioneer with its Sustainable Development Networks Programme and its ICT for development project. But the budgetary resources were limited, which meant that activities had to focus on information, awareness-raising activities and pilot projects.

The European Union commands significant resources for development co-operation, in fact significantly larger than the UN. But the European Commission has so far largely neglected the information revolution and its implications for development. This is in stark contrast to the efforts undertaken

within the Union itself. The European Commission has taken on a very active role in the promotion of ICT through the launching of eEurope – a broad programme aiming at enhancing ICT skills in society with special efforts made towards public schools, universities, SME:s, people with different kinds of handicaps, etc. One of the main objectives is to make sure that no citizens of the Union are being excluded from the technology developments.

If developments have been slow in the past as regards donor support to ICT for development, however important changes took place during 2000. In this year, major international bodies launched potentially highly significant initiatives to apply ICT to the needs of the developing countries.

The United Nations Millennium Summit called on the UN "to play a leadership and catalytic role in helping to bridge the digital divide and accelerate development by harnessing the development potential of information and communication technologies (ICTs)". A Special Task Force has been established to provide overall leadership in helping "to formulate strategies for ICTs development and putting them at the service of development for all, to forge a strategic partnership between the United Nations system, private industry and financing trusts and foundations, donors, programme countries and other relevant stakeholders, and to mobilize new resources for ICT for development".

Parallel to the discussions in the UN, the G8 meeting in Okinawa in July 2000 decided to establish two special task forces; one on the digital divide and one on renewable energy. The task forces included members from governments, the private sector, science and civil society. By initiating this work, the major economic powers of the world demonstrated their concern both for the issue of income poverty – access to modern energy services is a precondition for development – and information poverty. The two reports were presented at the G8 meeting in Genoa in July 2001. Both reports are of high quality and include a large number of very sensible recommendations. It is however not at all clear to what extent G8 countries will act upon the recommendations. Comments in Genoa, notably from Mr. Bush, stressed unequivocally that there was nothing binding about the recommendations. Leaving aside implementation, the two task forces did serve an important function. Their analysis is cutting-edge and they will most certainly be used to advance the agenda in terms of bridging the digital divide as well as promoting environmentally sound technologies in the South.

AN AGENDA FOR ACTION

Professor Jeffrey Sachs has pointed out (Economist, June 24, 2001) that the greatest divide between rich and poor nations is the inequality in innovation and diffusion of technology. Even as we speak this divide is widening. Among the solutions, Sachs suggests to follow the example of the Rockefeller Foundation in creating and funding great research centres around the world. New partnerships are also needed to bring together academia, governments and industry, from both rich and poor countries.

Capacity building in the new technology areas at universities, government institutions, schools, among entrepreneurs, etc, is a major prerequisite for technology leapfrogging to become successful. Furthermore, developing countries need considerable help to develop the right political, fiscal and legal frameworks to stimulate investments in ICT as well as ESTs.

One of the mistakes of the past was that development co-operation was primarily seen in the context of the governments involved. But experience has taught us that governments seldom are good at handling and managing technology. This should be the responsibility of the private sector. Hence there is a strong need in developing countries for new types of partnerships between the public and private sectors. This is particularly true in areas like telecom and energy, where rigid state monopolies very often are the main stumbling block for improvements in customer services.

There is no doubt that the economic opportunities which ICT generates will create a lot of wealth for those who master them. However, left entirely to market forces, these technologies are likely to marginalize the poor and disenfranchise them even more. A purely public sector approach will not work either. What is very much needed are partnerships between the private and public sectors, where the key role of the public sector will be to strengthen the capacity of all major sectors in society to have access to the Internet and to use it for their benefit. The private sector should be responsible for ensuring efficient and commercially viable dissemination of the technologies. Academia and civil society would help develop content so as to address important social, environmental and cultural needs in the process.

Many different kinds of technology can contribute to sustainable development. Some of these may be designed specifically to tackle environmental or poverty-related problems (e.g. solar photovoltaics). However, other technologies that have not been designed to directly address these kind of problems – like computers and mobile phones – will have an equally important role to play.

The technologies needed for sustainable development will differ from country to country. Those best placed to identify their technology needs are the different stakeholders themselves. However, they will only be able to do so if there is a supportive and enabling environment: if they have a well-developed skills base; strong, well-targeted programmes of research and development; an entrepreneurial private sector and if financing is available to the companies that are developing and utilising the technologies.

The private sector will need a lot of support in most developing countries in order to invest in the new technology areas. FDI flows are, as we know, concentrated in a few developing countries. For the great majority of countries the political as well as financial risks are perceived to be too high. Moreover, FDI will not take place in countries were the infrastructure in terms of roads, ports, telecom, energy, etc, is poor. A classic Catch 22 situation. Here the international donor community could play an important role by providing credits and risk guarantees.

Small-scale enterprises and service companies have a key role to play in developing and disseminating technology. Smaller companies in developing countries often experience difficulties to obtain financing. They are either too large for micro-credits, too small to qualify for project financing or perceived as too much of a risk for commercial loans. Strategies for providing funding to small private businesses need to be developed.

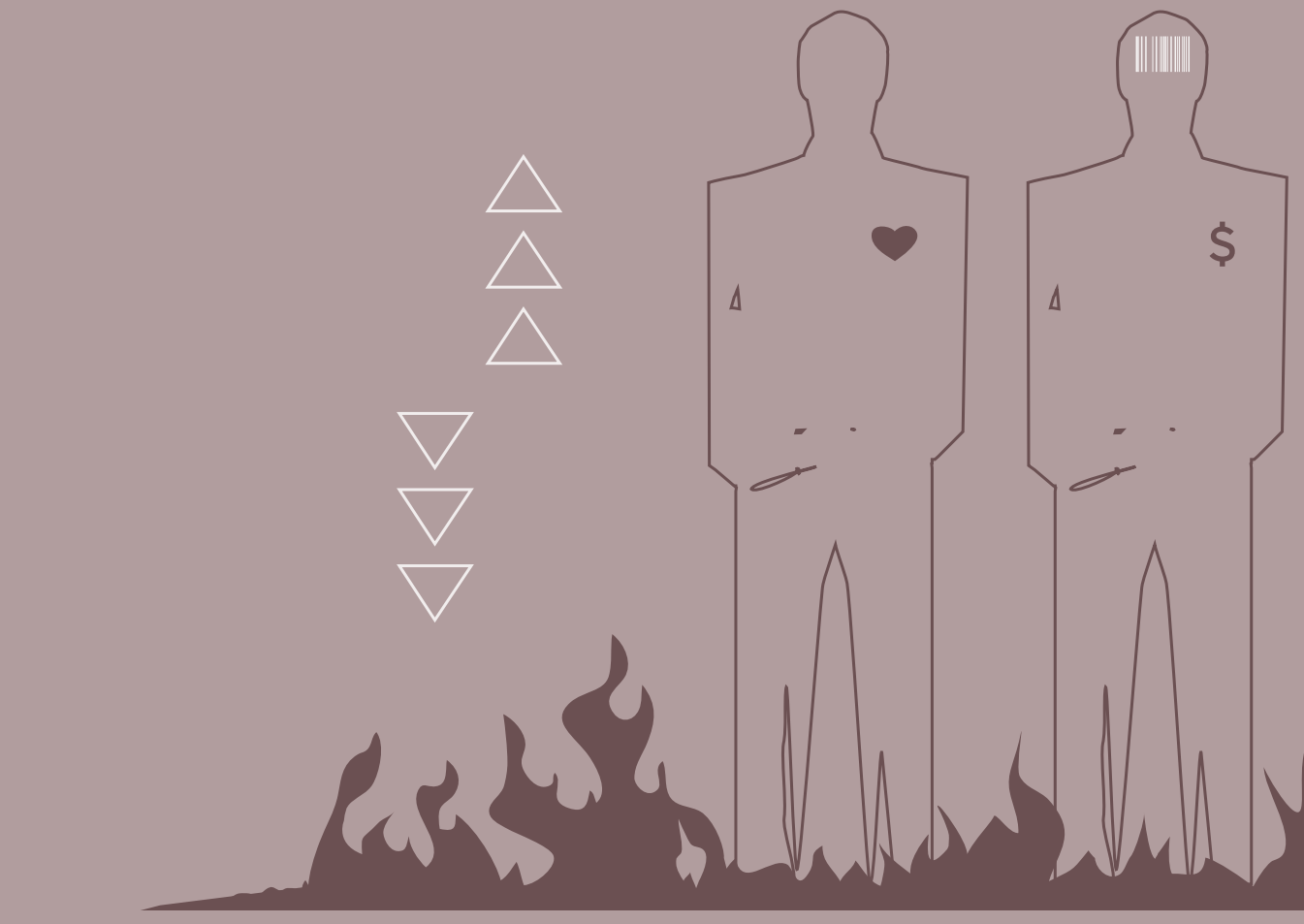
Closely related to the risk issue is the absence of sustainable business models for entrepreneurs and service companies in the field of ESTs. Here again, donors could help through support to demonstration projects, i.e. acting as agents of change. International funding, such as the GEF, could be used to cover the extra capital costs compared to conventional technologies.

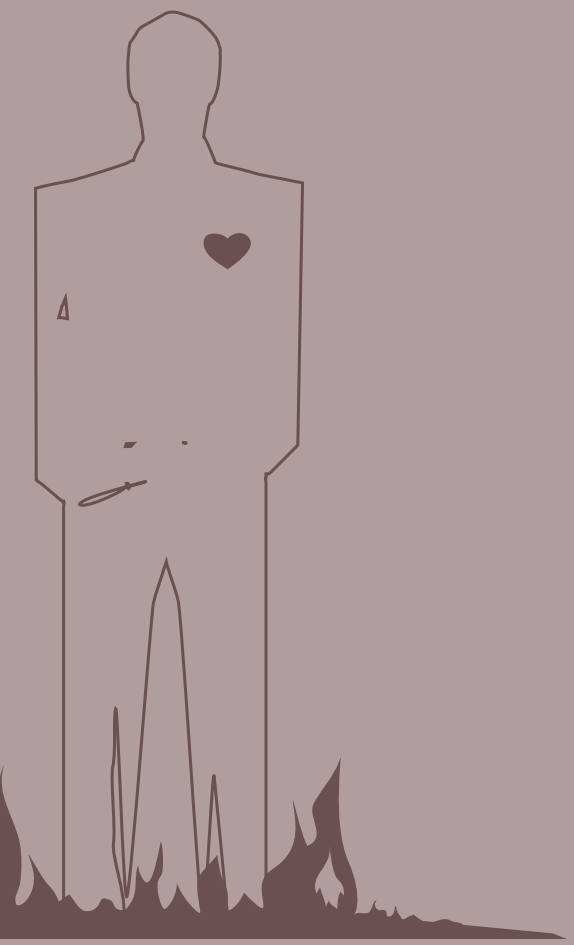
The international community should play a central role in assisting development country governments in pursuing the goal of Digital Opportunities for all and to support green technology leapfrogging.

The following priority actions ought to be considered:

- Support to national eStrategies, based on broad stakeholder dialogues. These strategies should include the development of regulatory and policy frameworks so as to improve competition in telecommunications and the provision of IT services to the public.
- Support for the establishment of community access points in all developing countries. The goal should be that all communities in the developing world should be connected before the end of 2004.
- Promotion of ICT dissemination among children in developing countries, notably by connecting schools and educational facilities. To be effective, such a program must be complemented by adequate teacher training.
- Support for university-based centres and research networks, focussing on research and learning at the intersection of ICT and development. Special attention should be given to content building within areas like tele-medicine, distance education, democracy and participation etc.
- Strengthen efforts to mobilize public and private support for improvements of basic ICT infrastructure in developing countries. Sufficient ODA funds – a combination of grants and soft loans – must be raised to cover political and financial risks and to guarantee connectivity in remote areas.
- Support to national strategies for sustainable energy, i.e. strategies based on energy efficiency and renewable.
- Support to capacity building within developing country governments for sustainable energy; the same capacity needs in donor agencies and development banks must also be addressed.
- Before 2010, reduce by half the number of people without access to modern energy services, notably through investments in renewable energy. This would require a crash programme in terms of donor assistance. Priority should be given to small-scale projects that meet local needs, and on leveraging private finance.
- The development of renewables should be strengthened through focussed R&D efforts and public procurement, thereby driving down the costs of ESTs.
- Launching of a special programme to promote renewable energy systems in remote locations to which traditional grid-based infrastructure does not reach. In such locations solar-based systems can be the only cost-effective option. Through such solutions, vital energy needs like lighting, refrigeration, etc, as well as ICT connectivity can be met.
- Encourage the use of Export-Credit Agencies to promote investments in ICT infrastructure as well as in energy efficiency and renewables.
- Make sure that access to modern energy services becomes part of developing country poverty eradication strategies.
- Promoting debt swaps, by making money made available through the HIPC initiative to support the implementation of technology development programmes.
- Promoting new international centres of excellence in research in technologies for sustainable development.

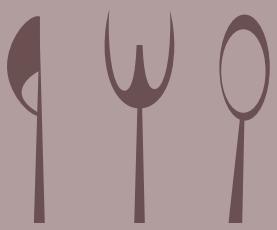
Many of the suggestions may appear unrealistic, given today's level of development assistance. However, to help address the digital divide and to assist developing countries in green technology leapfrogging should not only be seen in the context of solidarity with the poor. Of equal importance is to realise that it is in all our interest that countries in the South are not further marginalized and that the technologies used by them are environmentally benign. Hence we ought to see efforts to bridge the digital divide and for green technology leapfrogging as part of a shared responsibility, as part of joint efforts for the promotion of global public goods. If we take this angle, and we should, it ought to be possible both to offer Digital Opportunities to all and to reach another billion people with environmentally benign energy technologies before 2010.





CITIZENS OR EGOISTIC CYBER CONSUMERS - THE CULTURAL ROLE OF INTERNET

KALLE LASN



When you think of unsustainability and consumerism, when you think of re-inventing the "always-need-more-culture", they've got nothing to do with the Left or the Right, or being male or female, they are totally new issues of our time, and we have to find new tools with which to tackle those issues.

From this perspective Information and Communication technologies (ICT) are much more than just neutral tools and a new way of communicating. Depending on how this new technology is constructed, what rules we set up, and what kind of culture it transmits, it can either help us create a just and ecological sound society, or it could help us to accelerate and deepen the current consumer culture in which people and nature are measured only if they are able to make their voice heard through the marketplace.

Before we take a closer look at the cultural aspects of one of the most important media of our time, we must first take a closer look at the major actor of our time, the corporation. Not the local shop owner, but the major transnational corporations with revenues larger than most countries in the world. Among these corporations we find some of the leading proponents for the current development and the once that are doing their best to creating a society that are polluting not only the planet but also out minds.

WHAT IS THE SOUL OF A CORPORATION?

Even if we live in a time where major corporation influence almost every part of our lives, few people seems to know what a corporation is so let's start from the beginning. First of all, a corporation has no heart, no soul, and no morals. It cannot feel pain. You cannot argue with it. That's because a corporation is not a living thing, but a process - an efficient way of generating revenue. It takes energy from outside (capital, labour, raw materials) and transforms it in various ways. In order to continue 'living' it needs to meet only one condition: its income must equal its expenditures over the long term. As long as it does that, it can exist indefinitely.

We must realise that the role corporations have to day is not the only possible one. The first corporations, given license to operate in the 1600s, were strictly limited in scope and power by their charters. Corporations were kept on a very short leash right through the American Revolution and the early years of the new republic. When a corporation exceeded its powers or ceased to serve the public interest, its charter was revoked and its very right to exist was nullified. The people, not the corporations, were in control.

Well before the advent of "personhood" corporations had already been granted the privilege of limited liability, a key component of their immense legal power. What cemented the corporate position more than anything else, however, was the 1886 US Supreme Court ruling in a railbed dispute titled Santa Clara County vs. Southern Pacific Railroad. The ruling held that a private cor-

Courtesy of www.adbusters.org

poration was a "natural person" entitled to all the rights and privileges of a human being. It was one of the greatest blunders in legal history, and it triggered the corporations' 100-year march to global power.

When a corporation hurts people or damages the environment it will feel no sorrow or remorse because it is intrinsically unable to do so. (It may sometimes apologise, but that's not remorse that's public relations.) Buddhist scholar David Loy of Tokyo's Bunkyo University puts it this way: "A corporation cannot laugh or cry; it cannot enjoy the world or suffer with it. Most of all, corporations, cannot love." That's because corporations are legal fictions. Their "bodies" are just judicial constructs, and that, according to Loy, is why they are so dangerous. "They are essentially ungrounded to the Earth and its creatures, to the pleasures and responsibilities that derive from being manifestations of the Earth. Corporations are in the most literal and chilling sense 'dispassionate.'"

We demonise corporations for their unwavering pursuit of growth, power and wealth. Yet, they are simply carrying out genetic orders. That's exactly what corporations were designed – by us – to do. Trying to rehabilitate a corporation, urging it to behave responsibly, is a fool's game. The only way to change the behaviour of a corporation is to recode it; rewrite its charter, reprogram it. When a corporation breaks the law, causes an environmental catastrophe or otherwise undermines the public interest, the usual result is that nothing very much happens. The corporation may be forced to pay a fine, revamp its safety procedures, face a boycott. At worst – and this is very rare – it is forced into bankruptcy. The shareholders lose money and the employees lose their jobs. Usually, though, the shareholders move on to other investments, and company executives find work elsewhere. In fact, it's often the public and low – level employees who suffer the most when a corporation dies.

What if there was another, more serious, potential outcome, one that would lay responsibility where it belongs? What if each shareholder was deemed personally responsible and liable for "collateral damage" to bystanders, or harm to the environment? Why shouldn't it be so? If you're a shareholder, a part – owner of a corporation, and you reap the rewards when the going is good, shouldn't you be held responsible for that company when it becomes criminally liable?

If we rewrote the rules of incorporation so that every shareholder assumed partial liability, financial markets would immediately undergo dramatic change. Fewer shares would be traded. Instead of simply choosing the biggest cash cows, potential shareholders would carefully investigate the backgrounds of

the companies they were about to sink their money into. They would choose resource companies with good environmental records. They would stay away from multinationals that use child workers or break labour laws overseas. In other words, the shareholders would be grounded - forced to care and take responsibility. Stock markets would cease to be gambling casinos.

This new situation would also make the way corporations communicate and try to control information change. But that is not the case, yet, so let's look at the Internet the backbone of ICT.

PUTTING THE USE OF INTERNET IN PERSPECTIVE

In 2 000 years, our intellectual freedom has evolved from the right to hold opinions to the right to expression to freedom of the press. Now we need to fight for the legal guarantee of a redefined right of expression, one that's toothsome and enforceable. The right to communicate – to access – is the final, logical step. "Communication needs in a democratic society should be met by the extension of specific rights such as the right to be informed, the right to inform, the right to privacy, the right to participate in public communications," said author and long-time communication activist Howard Fredrick. "[These are] all elements of a new concept, the right to communicate."

A big part of personal freedom is the freedom to communicate. That, too, is as old as the ancient Greeks, who recognized the citizens' rights to hold their own opinions. With the introduction of the world's first mass medium - the printing press - it became apparent that simply holding an opinion wasn't enough. (The "Gutenberg revolutionaries" were continually censored and repressed when they tried to express their opinions on royal and religious matters.) So the notion of freedom of expression was born, guaranteed in the English Bill of Rights and finally, as printing presses and newspapers flourished, expanded to freedom of the press, guaranteed in the US constitution.
Article 19 of the Universal Declaration of Human Rights says, in part: Everyone has the right...to hold opinions without interference and to seek, receive and impart information and ideas through any media regardless of frontiers.
And yet, even in the beginning of the third millennium, with hundreds of newspapers, magazines and TV channels to choose from, with CNN beaming live news all over the world 24 hours a day and the digital revolution opening up the vast reaches of cyberspace for us explore, we find that the struggle for freedom of opinion, expression and speech is not over. One element is missing. Access.

If we can't tell our stories, share our fears and visions, register our dissent

Courtesy of www.adbusters.org

against a corporation or government that has done us wrong, then those vaunted the values of freedom and human rights aren't worth the sheepgut they're written on. Without citizen access to the most powerful social communications medium of our time, the market economy is a sham.

USING THE INTERNET

Above a discussed the lack of access in today's information society, but we must not forget how the system is affecting our mind and culture. If you spend enough time in cyberspace, emote commands start taking the place of emotions. "Emoticons" - those cunning little sideways faces typed with punctuation marks - substitute for real smiles and frowns. Over time, the computer drives out what we thought was an innate art: living through all of our senses. In her short story "Web Central," Fay Weldon paints a portrait of a dystopic future along these lines: The privileged classes sit alone in sealed rooms with computer terminals, their moods regulated intravenously.

The idea that spending a lot of time in cyberspace might have an ill effect on mental health has until recently been intuitively sensible but hard to prove. In August 1998, findings of the first concentrated study of the social and psychological effects of the Internet, a two-year effort by Carnegie Mellon University, were released. The results? Netheads were lonelier and more depressed than the average population. You'd guess that it might be because the lonely and depressed tend to gravitate to the Net. But that wasn't so. "Participants who were lonelier and more depressed, as determined by standard questionnaires at the start of the... study, were no more drawn to the Internet than those who were originally happier and more socially engaged. Instead, Internet use itself appeared to cause a decline in psychological well-being." "Connect, disconnect" may be our generation's answer to "Tune in, turn on, drop out."

Eventually, and perhaps sooner rather than later, there lies a world where most human beings are simply incapable of experiencing the emotions that life ought to evoke. Whatever they see or hear or taste, no matter how raw and beautiful, will promptly be pillaged for its usable constituent parts. And of course, once an emotion is corrupted, it can never be uncorrupted.

In John Irving's novel A Prayer for Owen Meany, the family matriarch dies in front of the television, rigor mortis sets in and her thumb is fixed on the remote. They find her body in front of the live set, the remote endlessly scanning the channels. It's a prophetic image. As we travel deeper into corporate - driven cyberspace, similar haunting figures loom on our own horizon.

Fractured humans are laid waste in front of their wall-size TV-cyberscreens. Their attention spans flicker near zero, their imaginations have given out and they can no longer remember the past. Outside, the natural world has all but vanished and the social order is breaking down. The citizens of this new world order are trapped inside their living rooms, roaming the thousand- channel universe and exercising the one freedom they still have left: to be the voyeurs of their own demise.

At the same time we see things happening under the surface. When I saw Fight Club I said, "Wow, this is quite amazing." I thought only a few culture jammers and people in the simplicity movement were really outraged by consumerism. And here is suddenly a film that was overtly giving expression to it and millions of people were going to see it and could identify with this kind of rage against consumerism that it portrayed. To me, it was a signal that things are moving in the right direction, and some portions of mainstream society are now getting this anti-consumerist message.

The film was released by 20th Century Fox. In this post-modern age, there are lots of contradictions like that. Even my book Culture Jam started off being published by a small publishing group, William Morrow, and then one month before publication, it was bought up by Rupert Murdoch and his HarperCollins.

PROACTIVE USE OF THE INTERNET

Even if I painted a pretty dark picture so far there are a lot of interesting things happening. We should recognize that there are huge opportunities to use the Internet as a proactive tool, challenging the current paradigm. I personally believe that culture jamming is the social activist movement of our information age. There have been three big social movements in my lifetime: the black liberation movement of the 60s, and then the feminist movement of the 70s, followed by the environmental movement of the 80s and 90s. Culture jamming, I believe is the fourth big movement that will now wash over our society and reinvent every nook and cranny of it.

So even if Internet today seems to be evolving into a commercial tool there is still room for democratic and radical voices. For our work the Internet has given us the opportunity to spread our message around the planet.

We communicated as best we could for many years without the Internet. We had 300 organizers around the world for Buy Nothing Day. We had to send them expensive packages through the mail. It was quite a cumbersome and

expensive system that actually stopped us from growing as fast as we could grow. As soon as we started making our posters available through the Internet – just print from the website, look at QuickTime versions of our TV spots, and order them if you want to – as soon as we offered those options on the Internet, things really started mushrooming on our campaigns. And the 300 or 400 people we used to deal with...as I said, it's now grown to over 50,000, and we are now a different kind of organization. We are grass-roots global. Before that, most of our activity was in the Pacific Northwest. Now, some of the most interesting BND jams happen in Australia, Israel or Estonia.

Even if we can use ICT in a proactive way our resources are very limited compared to the large economic actors on this planet. We should also not forget all those who never will get access to the Internet. This is true not only for a lot of people in poor countries, but also for a growing number of people in the rich countries. We need rules for ICT

REFORMING THE INTERNET

Even if there is room for some democratic non-commercial work on the Internet, that space is shrinking fast. Search engines are being bought up so you can pay to get "hit" by certain key words. At the same time media reform is not very sexy and very hard to pull off. But in a way, this is the big one, the ticket, the catalyst. What's at stake is who will control the production of meaning and the flow of information in the 21st century. Whose vision of the future will prevail?

If the communications system is built in order to generate economic profit for corporations we might not able to push through any decent sustainable transportation, nutritional, economic, electoral, or cultural agendas. We'll be constrained, if not outright prevented, from building the sustainable society of the future. But if we win our legal and moral battles, if the Internet is developed with the public good in mind, if TV networks are forced to open up the airwaves by a judge who upholds the First Amendment right of citizens to access the airwaves, then the payoff will be huge.

We'll have the first significant human rights victory of the information age. The commercial image factory will start closing down as people and groups stand up and speak back at their corporate "masters." We'll be released from a tyranny greater than any monarch's or Orwellian government's: the tyranny of packaged beauty, packaged stories, packaged heroes, packaged myths, packaged spectacles, the blight of a tested, flattened culture. We'll no longer have to swim in someone else's tank. We will be free to communicate with one anoth-

er. Unable to compete in an open marketplace of ideas, the sponsors of the old culture will be spooked. The enormous corporations like Westinghouse and Disney and GM will cease to be the omnipresent command centres of our consumer culture. And the mental landscape will be lit with sudden, telling moments of truth.

Five steps towards a new reformed global economy and Internet:

1. **True Cost:** In the global marketplace of the future, the price of every product must reflect its overall ecological cost. We cannot continue to prioritize corporate profits and low prices to consumers over our natural environment. This is a challenge for Internet, which tend to hide costs like transport and production even more than traditional shops.
2. **Demarketing:** The marketing enterprise has now come full circle. The time has come to un-sell the product and turn the incredible power of marketing against itself. We can manufacture uncommericals and subvertisements that uncool consumption. We need to keep the Internet free. As soon as important information on the Internet cost money we have created a huge wall in society between those who have and those who do not have access to information. The Digital Divide would then create the deepest inequality we have ever seen.
3. **The Doomsday Meme:** The global economy is a doomsday machine that must be stopped and reprogrammed. If the Internet is only a tool for marketing (B2C) and improving efficiency within and between companies' (B2B) it will do nothing else but accelerate the current unsustainable trend.
4. **No Corporate "I":** Corporations are not legal "persons" with constitutional rights and freedoms of their own, but legal fictions that we ourselves created and must therefore control. Corporations must be held accountable for their actions. Corporations should serve the interests of the people; not the other way around. The role of corporations needs to be regulated on the net in order to keep as much of it as possible free.
5. **Media Carta:** Every human being has the "right to communicate"- to receive and impart information through any media. Every person on this planet has a right to be involved in the development of the Internet. We must not accept a situation where the dissemination of computers with web-access is driven by corporations.

THE EVOLUTION OF MARKETING

Marketing:
selling society on an ever-expanding horizon of products and services.

Social Marketing:
selling society on a new line of ideas, lifestyles, philosophies and worldviews.

Negamarketing:
urging society to consume less electricity, gasoline, energy, materials, etc.

Demarketing:
unselling the consumer society; turning the incredible power of marketing against itself.

CON

OPPORTUNITIES AND CHALLENGES FOR TOMORROW'S SOCIETY

DENNIS PAMLIN

At the beginning of the third millennium, society is rapidly changing, growing away from the industrial age and towards something different. Depending on the perspective, this new society is referred to by many different names: information-, service-, post modern- and post-industrial society to name but a few, but regardless of the focus, one of the main driving forces enabling this change is information and communication technology (ICT).

A VISION FOR THE THIRD MILLENNIUM

ICT is, in many ways, a unique technology. It has the characteristic of a threshold technology, with the ability to rapidly change the whole structure of society and reshape the way our economy is organised.

It is probably not an overstatement to say that the change our economy and technological systems has entered into is of the magnitude of the industrial revolution of the eighteenth century, or even of that of the prehistoric agricultural revolution.

As an interactive technology that fundamentally changes ways and means of communication ICT will also create a cultural revolution, a revolution that could have a significant impact upon the way we perceive ourselves and the world, similar to the impact caused by the Copernican and Darwinian revolutions.

However positive the uses of this technology can be if aimed in a sustainable direction, it is important to acknowledge that ICT is not a panacea to the world's environmental and social problems. No matter how we use this technology, our society will continue to have an environmental impact upon the world and social tensions will continue to exist. There is no such thing as a weightless or friction-less economy: mankind will always need food and shelter, will own material objects, and will need transport for these as well as for itself.

All these activities will have an environmental impact. In the same way, ICT will result in new social situations where new actors emerge and new values are shaped. Even if the new society will be more just and equitable, people's views on how society should develop will still differ, as will their influence. Although this might seem obvious, discussions about ICT too often seem to forget that the "new" society is squarely based on the foundation of the traditional society.

When society is transformed from an industrial to an information-based economy, the problems of the industrial society will not vanish, since most parts of this society will still exist, even if in a different form. The information society will be layered atop the industrial society in the same way that the industrial society is layered over the agricultural society.

Needless to say, the development of the new form of economy will not take place simultaneously all over the planet, nor look the same everywhere. It is therefore pointless to try and draw a distinct line between the so-called old and new economy, as this blurred line is drawn in time, includes all sectors and contains gradual changes mixed with sudden shifts.

As the infrastructure for this new society begins to come into place, there is

a unique opportunity to shape the whole system in a way coherent to humanity's needs and visions for the future. Thus, while it is important to find the economic, social and environmental triple-win situation today, it is even more important to find in which way to direct development in order to create a structure where most situations have such successful possible outcomes.

The complexity of ICT makes it difficult to approach in a traditional manner, which focuses only on the direct impacts of extraction, manufacturing, use, and disposal. It is vital that all due caution be taken when responding to ICT-based challenges.

The impact of ICT must be viewed in a very broad sense, from cultural changes caused by the use of new technologies, to the appearance of new possibilities for shaping a new economy in which production and consumption patterns look fundamentally different. The impact of E-shopping, for example, cannot be reduced to the computers used for the transactions, or even to the eliminated car trip to the store. Instead, the whole distribution chain must be examined to determine what kind of long term impact this kind of consumption will have on the economy, the development of the infrastructure, as well as upon habits.

To complicate things further, the development of ICT will also create new economic, legal and cultural "meta challenges". Not only must society learn to think in new ways when working with ICTs, but existing actors, institutions and sectors will have to rearrange themselves. Some of these participants must abandon areas that they used to dominate, and others must expand their field of responsibility – and obviously new institutions and networks will need to be created during this process.

As the speed of change is so fast, the need for flexible measures and the ability to allow new ideas the room to evolve will be very important. At the same time, a period of rapid change tends to frighten both people and institutions into defensive positions, in which it seems easiest to revert to well-known ways of thinking and well-known ways of work. This creates a challenging situation where the need for new thinking and for new ways of solving problems will be confronted with groups trying to protect what they control today, fearful of losing influence in a society with new ground rules and new goals.

It is impossible, and therefore unwise, to try to give a final answer to the question of how to direct ICT development so that it supports sustainable development. Notwithstanding that total solutions have always led societies into dead ends, the rapid change society is going through will make all specific

recommendations outdated before they can be applied. A beginning can, however, be made by developing a framework for sustainable ICT development; and in doing that we can hopefully create an atmosphere in which a critical mass of different actors start to move in a sustainable direction.

In an attempt to inspire a discussion about the prerequisite for a sustainable framework where ICT is a part of the solution instead of the problem, this text will go through three steps. First, we will look at two overarching questions that must be discussed by all actors in society. After that, four sustainable ICT principles will be introduced as a guide for drafting long term strategies in different areas, including the private and public sector, as well as civil society. Finally, seven strategic areas for ICT are presented, focusing attention on a number of strategic challenges. Progress in these areas, or lack of it, will be an indicator of whether the use of ICT is contributing to a society that moves in a sustainable direction or not.

I

I. OVERARCHING QUESTIONS

With society going through major changes, implications for the fundamental structures in society must be examined. This first chapter therefore scrutinises ICTs role in two areas, examining its impact on democracy and on the economic system. These repercussions are easy to loose track of when facing a number of challenges that require immediate action, but the long term and structural implications must not be neglected.

It is time to realise that the shift to an information society is much more than a technological development that can be left to a few individuals and companies to develop. All of society's members should be able to express what kind of future they would like to create, and discover how they could contribute to these developments in a sustainable context.

This text aims to inspire further discussion upon these topics, whilst highlighting the important aspects of ICTs relation to democracy and the economic system, and indicating a path for the future.

1. Democracy

"Nam tua res agitur, paries cum proximus ardet"
Quintus Horatius Flaccus

Before discussing ICT and democracy, it is helpful to step back and look at the original meaning of democracy. The word derives from the Greek word

demokratia, a combination of demos, "people", and kratos, "rule". Hence, democracy strictly means rule by the many instead of by the few, based on the belief that everyone in society should have the same basic rights and freedoms and that people should be free to govern themselves.

Today most democratic nations are representative democracies, where the people elect public officials, with the expectation that the latter act according to the desires of the people. Popular sovereignty is still supposed to be at the heart of democracy, with the wishes of the people supreme, and not the individual leaders, political parties or groups with money and power.

Many of the trends seen today contrast the manner in which democracy is ensured with new challenges. For example, many large corporations grow fast and already have significantly more resources than many developing countries, the technological development is fast and complex, new ways of communication are dominated by certain participants within society, and there are multiple threats to the planet that cannot be solved on a local or national level. Democracy and the democratic framework needs to evolve to be able to face such supranational issues.

With the growth of ICT, all societies, whether democratic or not, have been given a new context. The opportunities and challenges for democracy are significant, and of different kinds, which may be divided for convenience into three different groups: the first relative to the technological and economical situation, the second to information and knowledge, and the third to the cultural environment.

- Technology

An important technological and economic challenge, and one that is frequently mentioned in the context of democracy, is access to the technological tools that help find information and communicate. If ICT is to be used as a democratic medium, every citizen must have easy and affordable access to ICT-enabled products.

At the global level, the need for action is obvious. International negotiations affecting everyone on this planet are frequently developed in different drafts that are circulated, discussed and commented on over the Internet. This has created a situation where anyone who wants to take part in the development of the global framework, including the development of ICT, must have access to ICT. At the same time, it is obvious that many of those who really need to be a part of these discussions do not have access to ICT.

One of the groups excluded from these discussions are the world's poorest

countries. Their biggest problem, however, is usually not access to ICT, but the lack of capacity to process all the information to which it gives access. This is partly due to their lack of ICT infrastructure and equipment, but also to the lack of other basic resources.

When looking at exclusion from an individual perspective, it becomes clear that we must go beyond the country and state perspective when addressing excluded groups. Small and medium size enterprises, small scale farmers, the unemployed, young people, ethnic minorities, and those with values difficult or impossible to assess in monetary terms, are all groups that have difficulty participating in the discussions that shape the global framework due to their exclusion. Many of these groups come from economically disadvantaged countries, but far from all.

In a global society, with many challenges facing humanity, it is difficult to envisage a situation where democracy is the guiding principle without ensuring that each and everyone can make their voice heard. With ICT becoming a necessary tool for influencing and participating in the development of the policies and organisations that will shape the future, as well as a tool for sharing information between citizens, universal high-speed access must be placed high up on the international agenda. Naturally, traditional basic needs must also be addressed. However, instead of treating access and the ability to communicate as a luxury, as is frequently the case today, it must be considered as a fundamental pillar of any serious development policy.

A second, less frequently discussed but no less important challenge for democracy is linked to the rapid technological development of ICT. ICT is an integrated part of a broader technological development, including tailor-made chemicals, biotechnology, robotics, quantum computing and nanotechnology. New groundbreaking innovations can be expected to come out of research laboratories in the near future, with others already available on a large scale. A key challenge is how to democratically aim the development of these technologies in a direction that support sustainable development.

With an economy that demands fast and high rates of return, incentives increase to put new technologies on the market before properly discussing and assessing their social and environmental impact. The use of ICT could, if used in the right way, facilitate and speed up proper assessment of new technologies, as well as a broader discussion of the current technological development.

Looking at the technological development from a broader and long term democratic perspective, the questions that should be at the forefront of the

issue are: Which kind of technologies do we need to meet the needs of tomorrow? Are technologies that are easier for all citizens to understand and that are locally developed better for democracy? Should incentives be introduced to reward these technologies in some way?

Today such incentives are reversed, with the result that corporations patent complex innovations to sell them free from competition on a global market. There are good arguments for the current system from a traditional economic perspective, such as economy of scale, but for democratic reasons incentives should be considered that even out the market for other, less complex and locally developed solutions. This is not to say that centralised high-tech solutions could not have an important part to play, but that other approaches also should be encouraged in order to find sustainable solutions.

- Information and knowledge

The broad introduction of ICT has already fundamentally changed the ways information is used, processed and disseminated. Historically, political and economic systems used to work within a timeframe of a few years and sometimes months. During the Industrial Age, elections and annual reports were the events around which the important decisions of modern democracies have revolved. This limited timeframe has, however, often proven inadequate to deal with many of the challenges that affect nature and future generations, especially when looking years, decades, or even centuries ahead.

As ICT spreads through all levels of society, the pace of economic and political decisions has accelerated even further. Today reactions on the stock market and opinion polls pressurise many groups into using time frames of weeks, days or even hours. The introduction of information technology over the last few years has for example made it possible for global financial markets and others to react and act within minutes, or even seconds, to different events around the planet.

Thus, when something happens that affects the economy, the large financial and economic actors usually react in a matter of minutes, followed by the media, then by a political decision in response to the media and pressure from different groups, followed by another market reaction, then by another media reaction…

The need for rapid response increases as the social changes accelerate and different groups try to process new information. In this situation, it is easy to portray the potential responses to the challenges in a dichotomised manner, since there is little time for reflection. This trend is frequently encouraged by

the mass media, where a simple and overly dramatic approach built on familiar and well-known ideas is often considered the best. In a democratic society that must take decision regarding complex questions with far reaching consequences this is, however, a dangerous tendency, as it discourages dialogue and the understanding of different and new perspectives.

Sometimes the actual social and environmental implications do not even influence the process where the different actors try to foresee the next move of the other actors without checking out what the real implications are. As the real world is influenced by the reactions on the market, political decisions and how media portray reality, today's society is in a situation where the relation between fiction and reality often are difficult to understand. Some would even claim that it is impossible to uphold the traditional idea of a difference between the real and the virtual.[1]

ICT solutions need to be democratically encouraged so as to create a situation where actors with different perspectives can meet, and where the general public can get information about what these different groups decide upon, whilst reflecting both sides of the debate.

- Culture

Historically, democratic societies have been organised around certain geographical boundaries, where nations, states and corporations exist. However, modern democracy is a relatively recent invention, and has not been around for more than 200 years, even if the concept that a free people should govern itself has been in existence for more than 2000 years. The current structure of society, including representative democracy, is something that to a great extent was created as a response to the industrialisation process that took place during the last two centuries, and was thus imposed from above on nations and states that had evolved from feudalistic concepts.

Globalisation has brought many changes to current institutions. Many new challenges requiring a solution are global or regional. A large number of transnational corporations have become increasingly powerful, and may act with little concern for national borders. An increasing number of individuals are also part of different international networks, through their profession or personal interest. In many cases, traditional borders today can be said to be of little or no interest – and where there is no national context, a culture is created in which people's identity and interests do not necessarily coincide with national or local geographical boundaries.

In this situation, it is not surprising that the role of the existing structures, including democratically elected governments, are now being questioned. Many groups trying to achieve specific objectives, in environmental, social and other matters, have also shifted their attention from democratically elected institutions and have turned towards large corporations. This is a logical step for those wishing to achieve short term results, but what long term implications will this have for democracy?

By its fundamentally networked nature, ICT brings people together and enables groups to meet their objectives without necessarily going through the traditional democratic structures. This could potentially enhance democracy in the future, but could also undermine the current structures that are intended to guarantee democratic development, without replacing it with a new democratic structure.

Many special interest groups have clear and specific objectives, such as human rights, certain environmental problems, or in the case with corporations, profit. Of these groups, very few are engaged in broader issues that deal with the future of our democracy. The result is that many of these actors, in most cases unintentionally, erode the old democratic structures without replacing them with new democratic structures.

Another challenge relates to the kind of information that ICT helps to spread. So far, those economies wherein most hardware and software used for ICT are developed have focused on satisfying mainly material needs. These material needs are satisfied thanks to two types of information: first, "coping information", the kind of information needed for basic survival; second, "helping information", i.e. how to survive in the most efficient way. This last kind of information has ripened to an extreme extent in the current economic system, coming to include almost all economic information that perceives individuals as customers for any nebulous product.

The above information is clearly needed, but a society also needs to give room for information that goes beyond material needs. "Empowering information" is required in order to build relationships between people, and to facilitate the development of human beings in everyday life. There is also a need for "edifying information" or "wisdom". This last category includes more reflective and transcending experiences, ethical or philosophical information that has to do with moral and ethical questions.

A society needs all these different kinds of information, and different structures for distributing them. Unfortunately, the different kinds of information

are often considered as dichotomous, when they should be looked upon as complementary. Food, shelter and other basic necessities are a pre-requirement to having time to consider questions about relationships and the meaning of life. However, in materialistic societies, moral and ethical questions often end up neglected. It is interesting to observe that specific cultures with much less material welfare than western society seem to have developed further in regard to perceptions of non-material and consumerist issues.

If a sustainable democratic society is to evolve, which includes time for reflection upon ethical questions, an economic system is required that can deliver enough material goods for all as well as give room to broader human development.[2]

There is no "right" answer when it comes making choices for tomorrow's society, and there is a significant need for democratic arenas in which to discuss the choices faced. Fora and platforms should be created where different stakeholders can meet and discuss the opportunities and challenges that ICT brings on all different levels; local, national, regional, and global. In the process of developing the new democratic framework, we must not limit ourselves to the traditional structures: instead, different networks should be created, focusing on different areas, creating global clearinghouses for ideas and needs. At the same time, existing democratic institutions should be consistently respected, whilst developing the current system into a structure that can cope with new challenges.

2. The economy

"The day is not far off when the Economic Problem will take the back seat where it belongs, and that the arena of the heart and head will be occupied . . . by our real problems – the problems of life and of human relations, of creation and behaviour and religion."
Keynes, J.M., Preface, Essays in Persuasion, 1931

What do the new concepts of the information society, post-industrial society, or service society imply for the economy? Whilst pondering an answer, it is important to remember that most of the challenges related to the industrial economy will still be with us for a long time. However, today's situation should be acknowledged, with a significant number of people on this planet, mainly in more economically developed countries, living to a standard that people have dreamt of throughout history; without having to fight everyday for food,

shelter and health. Mankind's primary focus in many regions is no longer simply upon survival. Unfortunately, the way in which this situation was achieved is far from perfect, and the rest of the world cannot develop along the same path if an ecological and social disaster is to be avoided.

The fact is that if every human alive today consumed natural resources and emitted carbon dioxide at the same rate as the average American, German or Frenchman, at least another two earths would be required for this to be sustained for any length of time.[3]

As new technologies evolve, the possibility for a highly integrated global economy has emerged. However, economic development in different parts of the globe will naturally not be a carbon copy of western societies industrialisation process. The question then is what will global, regional and local development look like in an economy where the material needs of the world's population are met within the carrying capacity of the planet.

It is in this dynamic and complex situation that ICT can play a crucial role. Approaching the question of ICTs role for a sustainable economy, two points must be kept in mind. First, there should be a balance between marginal changes and structural changes when trying to direct current economy in a sustainable direction. Secondly, ICT must be used in a flexible way, depending on the specific situation, in order to meet very different needs in different parts of the word, while still working in an economy where the interdependence is high.

- Marginal and structural changes

It is easy to see that ICT has the capacity to dematerialise certain products, such as CDs and books, and turn them into services delivered by electrons instead of atoms. ICT can also make many current processes more efficient by supporting more and better information. The way information is processed and shared opens up new possibilities to pooling problem-solving capacities. New ways to monitor different processes could also open up new ways of responding more accurately and faster to problems as they emerge.

These would be important steps forward, but are still insufficient to achieve long term sustainable development for all people on this planet. Marginal improvements in the existing system must therefore be complemented by structural changes. This is even more crucial as some marginal improvements in evidence today are counterproductive. Instead of being a step towards sustainability, these counterproductive marginal improvements lead to dead ends where resources are wasted in bolstering a system that cannot be

further improved. Many of ICTs most important contribution to sustainability will therefor take place when it contributes to a structural shift of our current economy, requiring a new use of ICT in our infrastructure systems like transport, housing, agriculture and energy production.

In order to reap the full potential of ICT there must also be a progress away from the industrial perspective where human beings are reduced to being either a part in a production chain or a consumer. In a post-industrial society, human beings should be seen as creative citizens with dreams and visions, and the economy as nothing more than a tool to realise these dreams and visions.

When it is said that politics are dead or that we have reached the end of history, it might be of some relevance in the context of the old structures of the modern industrial society, but when looking at ICT and the future beyond the industrial society, nothing could be more wrong.

- In developed countries

The chance for change must be seen in today's context, where ICT is being developed in societies that still seem unwilling to move away from a single minded focus on "more". GDP growth is still widely used as a measure of development and progress, although there is a clear need to further qualify what "more" is required.

Even if there are attempts to improve the current growth paradigm, most institutions still encourage increased consumption and more production relentlessly, and do so without any tools separating desirable growth from unwanted and negative developments.

It is clear that in western countries, the emphasis must be shifted away from providing more material goods to providing better and smarter services. In this process, the economic system must be modified, with new indicators providing a more correct picture of the state of society than do today's "compasses", such as Gross Domestic Product (GDP). With networked technology providing more and better information about the state of the economy, there is also less need for simplified and aggregated economic measurements that do not necessarily show the whole picture.

The future of ICT could be a part of what would be one of the most important steps in mankind's history; a step away from a society focused on material needs, towards a society engaged in pursuing that which gives life a moral and ethical meaning. In this process, the economy must be viewed as a mere tool for the creation of welfare, material goods and services that simplify personal development.

- In developing countries

In relation to the world's poorer countries, ICT faces important challenges. It must contribute to bringing together all parts of the world to reach a situation in which every individual can meet their basic needs.

As the more economically disadvantaged parts of the world cannot take the same developmental path as those that are already industrially developed, ways must be found for these countries and regions to leapfrog economically and socially over the more wasteful and polluting societies. If this does not take place, the current loss of valuable nature and the extinction of species will not only accelerate, but increased tensions within and between countries, the haves and the have-nots, will be created, causing potential flash-points for conflict, and worse.

- On a global level

The biggest danger on the global level from a sustainability perspective is if ICT only will be used to make the existing economy more efficient. As influential groups might try to use ICT in order to reap short term benefits, globally targeted policies must be carefully developed so as not to create the wrong incentives, since this could worsen the current negative social, economic and ecological trends.

The complexity of the different societies in the world existing in parallel with different needs must not prevent action. As the world becomes more economically integrated, the need for specific and targeted solutions will most likely increase. In this situation, simple solutions such as "free trade" or "economic growth" must be used with caution. If history has one lesson to teach, it is to be careful with simple and "obvious" solutions.

As for global institutions, the challenge is significant, as they have to address different kind of needs. There are still large areas of the world that lack fundamental services, food, housing, medical care, etc, and those may still use parts of the old economic models in their development process, whilst incorporating environmental and social aspects. At the same time, other areas need to redirect their economy away from material production and consumption.

II

II. SUSTAINABLE ICT PRINCIPLES

It is hard, if not impossible, to direct in a specific track any dynamic society going through rapid changes. Many actors, new inventions, new values and unforeseen events are interacting with each other and, often with the help of ICT networks on different levels, cross-pollinating each other.

What makes current developments even harder to direct is that there is not merely rapid development along several different paths, but also a situation in which the entire system, as well as parts of the system, are in the process of leaping from one level of importance to another. Different subjects, organisations and technologies that have existed on the margins are therefore all of a sudden becoming the centre of attention.

Accepting that there is no concrete program for the future, no perfect utopia, it should still be possible to identify a number of principles for the development of ICT that could be used for guidance. In this chapter four key principles will be explored that could help in the sustainable development of ICT systems, technologies and applications. These principles are general and designed to be introduced by all actors in society, including companies, governments and NGOs.

1. Focus on service, not products

"There is enough in the world for everybody's need,
but not enough for anybody's greed." *Gandhi*

The first principle of sustainability focuses on what is needed. In a society where the economy has been designed to solve the problems of material scarcity, the focus revolves around maximising the material output. Most existing structures and institutions in the industrial society are therefore formed to maximise the production and distribution of basic material needs, such as food, housing and medicine. Today, when large parts of society have their material needs satisfied, the situation is different, and the provision of services has come to the fore. Two issues must, however, be highlighted:

First, the existing focus on "more" has resulted in a wasteful economy that barely acknowledges Nature or social concerns. This system is not sustainable, and needs to be entirely rethought in order to lift the whole world to a sufficient level of material welfare, whilst remaining ecologically and socially sustainable, and providing the more intangible benefits of a society where more ethical concerns are the focus.

Second, and even more importantly, in the more affluent parts of the world, most people do not need more products in order to increase their welfare. They might need better products, but far more often what is required is better services, or that which has become the most precious commodity in our society: time.

In order to change today's society and culture to one focussing on quality and service, a paradigm shift is required. This shift, would, however, be more linked to changing mores than to the external and superficial aspect of institutions.

- Products

Every product that exists or is planned should be examined to determine whether the service provided by the product is a necessary one, and the best manner in which to deliver that service. If this is the angle taken from the beginning, a more dynamic environment will be created where people, institutions and corporations do not feel tied to a certain way of delivering a service.

- Structures

Investigating the substitution by services of today's products, a number of important improvements can clearly be achieved, however, they will remain marginal. In addressing most of today's important issues, the larger infrastructural systems also need to be examined.

Two situations in which a change in focus could have dramatic repercussions for the environment are: the production of energy, and the provision of transport. Almost all participants involved in today's energy systems focus on energy production, and not on sustainable energy services. With regard to the transport system, the responsible departments in governments and the corporations involved all have their focus on physical transport, and most specifically on transport by road.

By shifting focus, the emphasis could be changed: instead of coal, oil, fossil gas and nuclear power, energy services themselves would be the hub; instead of cars or even transportation, communication would be the focus. This change of focus can be relatively simple, as demonstrated by an increasing number of participants within these industries who see the possibilities in this change, but it is hard to change structures wherein "experts" have invested much of their time, energy, and pride.

What the service definition would look like would depend on the situation. With regard to the transport industry, an airline might transform itself into a meeting company and introduce videoconferences as a complement to the tra-

ditional business, while another might define itself as a transport company and look for sustainable ways to transport goods and people. In the same way, one manufacturer of fridges might shift to become a supplier of cool space, and another supply fresh nutritious ecological food.

As the focus shifts, it is important to be open, and communicate different possibilities. As technological breakthroughs make new things possible, the need should be communicated and prioritised for solutions that could make the different systems truly sustainable. There is often a reluctance today to admit that current systems are far from sustainable, with the result that it is hard for other participants in society to see what kind of needs exist and how to contribute to sustainable development.

- Culture

Marginal and even structural economic changes are insufficient to address the dominant culture that equates increased material consumption with improved welfare. Today's economic system creates frustration, and much indicates that many would like to live in a culture where more room is left for reflection, participation and discussion. ICTs role in enhancing these elements will be a great opportunity for change, despite many traditional influential actors seeing this as a threat to their short term profit. On the other hand, many would probably enjoy the challenge of solving many of today's problems, and of being a part of a cultural change where "quantity" is left behind, and a new focus put on "quality".

If we are to shift from a product-focused society to a service-orientated one, we must look at what kind of culture is promoted by the ICT system. As the ICT-system develops, there must be room for values beside consumerism. If those using ICT are treated only as consumers and never as citizens, a global ICT-network might turn out to be the biggest threat to sustainability ever encountered. A global culture based upon the frustrating feeling of not being able to consume as much as wanted, and with little or no time for reflection and discussion about other values or the future of society, leads a clear comparison with Aldous Huxley's "Brave New World".[4]

- Conclusion

The shift from product to service should not be perceived as a mere technological issue, since it is a change of perception that goes far beyond substituting as many of today's products with services as possible. It is about fundamentally questioning what society needs, and how these needs can be

met in an ecologically sustainable and ethically acceptable manner. Furthermore, this shift must not result in a situation wherein the actual products are forgotten, since all systems have ecological and social footprints and that must continuously be discussed and kept in mind.

2. Reduced rebound effects

Prospero: "I have done nothing but in care of thee."[5]

When a new technology is introduced in a rapidly changing environment, unexpected problems should be expected; so-called rebound effects. These effects occur when an unforeseen consequence in one part of the system is the result of an attempt at problem solving in another part. As ICT, by its very nature, is a network technology, the rebound effects can be significant.

One key challenge from an environmental perspective is that the main driving force today behind the growing use of ICT is not sustainable development, but the urge for short term profit. Increased competitiveness, shorter time to market, increased profit margins and increased market shares; these are the principal reasons for investing in ICT technologies today. Occasionally these goals may result in a better environment and improve the social situation, but this is relatively rare. By introducing environmental and social considerations from the beginning, many problems could be solved before they even occurred. As no one wants to destroy the environment, create social problems and exacerbate inequity, there should be good opportunities for addressing the existing and potential rebound effects as the new ICT infrastructure is built.

The rebound effects that need to be addressed can be divided into three different categories: direct rebound effects, indirect rebound effects and systemic rebound effects.

- Direct rebound effect

With ICT penetrating through to new layers of society, many new products will be introduced, and some old products will be altered to include communications capacity. The potential direct rebound effect of this development could result in a significant increase of new materials as well as increased energy use in different sectors.

Two issues are important in this area. First, many of the direct rebound effects can easily be addressed by the introduction of environmental concerns early in the development process. In many cases today, corporate R&D divi-

sions are not even aware of phaseout scenarios for toxic substances, and the need for minimal use of energy in all modes and functions.

Secondly, the final product must not be the only focus when analysing material use and energy consumption. Even if the product itself does not contain much toxic material or use a lot of energy, the production process might result in toxic waste or be energy intensive. To solve this problem, all toxic substances should be avoided as far as possible, as should materials that generate toxic material when produced. Furthermore, all energy that is used over the product cycle should come from renewable energy sources. To reduce the material needed for production, products should be designed in modules that can be easily updated and recycled.

It should also be acknowledged that a negative rebound, with effect upon the public image of these products, could be the result if unintelligent solutions are introduced. A situation with higher energy use and more toxic substances released into the environment could create a situation where all ICT-actors would run the risk of being perceived as not taking sustainable development seriously. All serious ICT actors should therefore disclose phaseout strategies for toxic materials and their energy efficiency work.

- Indirect rebound effects

Indirect rebound effects are not due to the products themselves creating a problem, but to the result of ICT use. These rebound effects are harder to address as they are often beyond the direct control of the ICT producer or user.

The most common example of an indirect rebound effect relates to E-shopping. Many times E-shopping "saves" a trip to the shop, with it's attendant pollution and waste of resources, but this environmental gain can easily get lost with an inefficient distribution system. This phenomenon is sometimes called the "Harry Potter rebound effect", after the event when a new Harry Potter book was sold over the Internet after an intensive marketing campaign. All E-buyers were promised that they would have the book the same day it came out. The result was an extensive transport operation, including airplanes and lorries. Thus, this way of distributing the book was probably one of the worst possible ways from an environmental perspective.[6]

Other indirect rebound effects relate to new cultural and behavioural patterns. A number of virtual contacts with people all over the world, no matter whether professional contacts or personal, could result in an increase in transportation when contacts wish to make the event "real". On a local scale, specific

issues arise when telecommuting becomes more popular. Even if travel to work did decrease, other travels might increase, as telecommuters still need to buy food, obtain childcare and make social visits.

In order to avoid such situations, governmental policies and private investments must be made with the aim of reducing all possible indirect rebound effects of ICT as much as possible.

- Systemic rebound effect

When looking at rebound effects, a distinction must be made between temporary transitional indirect rebound effects, and long term systemic rebound effects. In some situations, a higher environmental impact during a short transition period could be necessary to reach a long term sustainable development path. In the same way, a short term improvement can result in a long term systemic rebound effect.

Three of the most serious potential systemic rebounds effects include more transport, more land use and increased consumption.

Increased transport is the most obvious systemic rebound effect. If ICT does nothing more than to accelerate the current trend, it will increase the need for the transportation of goods, even if this is done in a slightly more efficient way. As transport, for the near future, will take place by vehicles using fossil fuel, this is a serious challenge in a situation in which countries that are more affluent must reduce their emissions of carbon dioxide by 60–90 percent.

With more control over supplies, less space would be required for storage in warehouses, but on the other hand, it could result in a situation with more goods on the roads, on the way to different shops and factories. ICT also makes geographical distances less visible, and when using ICT it can be difficult to find out where the product being bought is from, geographically. By using the technology without analysing the long term consequences, incentives for investment in the traditional transport sector can easily be created, resulting in more aeroplanes, lorries and cars, all increasingly polluting the environment and increasing land use.

By using ICT, geographical borders could become less important. This would create incentives for companies and individuals to move to new, still unspoilt areas – and these new settlements would interfere with the small spaces of nature left that humans do not yet dominate. Combined with increased traffic the result would be an even more fragmented environment.

As ICT gives opportunities to consume more and more, the risk of increas-

ing the environmental pressure on our planet and increasing our ecological foot print also expands – along with the risk of creating a culture with no link to nature, and very little time to reflect upon what is important in life.

- Conclusion

In order to direct ICT development in a sustainable direction, the different rebound effects must be analysed. This will require new networks, where groups that usually do not have much contact must discuss the challenges. Furthermore, tools must be developed to assess and share information on the different kinds of rebound effects, especially for the systemic rebound effects.

3. Robust systems

"To err is human but to really foul things up requires a computer"
Paul Ehrlich, 1978

When encouraging the development of a sustainable ICT society, it is tempting to give examples of perfect solutions to today's ecological and environmental problems. Unfortunately, many of these solutions only work under perfect conditions, and their performance under other circumstances can turn out to be counterproductive.

There are two main reasons for the exaggeration of ICTs performance. Firstly, many of those working with ICT are used to talking about efficiency gains of hundreds to thousands of times, and about entirely new ways of solving problems, and understandably want to push the limits. Regrettably, unforeseen, or unlikely, events may be overlooked when the focus is on the highest possible number in a best-case scenario.

Secondly, in order to attract investors and customers, those involved in development and construction of new ICT-enabled products must be heard loudly and clearly in the market. The easiest way to attract attention is to communicate the simplest and most positively staggering numbers – even if these are only valid under certain circumstances.

To strengthen the robustness of the ICT system, three factors should be included in all discussions about new ICT systems and products: possible technological and human errors, feedback mechanisms, and a "cradle to grave" perspective. If all three factors are included, there will be an improved chance of obtaining solutions that resemble dynamic living systems. ICT sys-

tems would then be able to handle a vast range of disruptions – however, everything has limits, and when those are reached, the system breaks down.

- Technological and human errors

One good example of where ICTs potential to solve important problems must be dealt with in a responsible manner is product tagging, i.e. providing products with their own identification card. This technology will probably revolutionise the way our economies work, as well as improving environmental protection, making a significant contribution in improving production efficiency and inventory. At the same time, the introduction of new technologies should not be used as an excuse to delay or halt the phaseout of the most toxic substances Keeping this precautionary principle in mind, even a robust ICT-system controlling toxic chemicals should not include chemicals that could be very harmful to the environment.

Another kind of problem relates to the problem when different parts must work together. Often the different parts of a larger system may function effectively, but when errors are encountered, problems such as the "Nimbus-7-blindness" might occur. This name refers to a satellite that was measuring the ozone layer effectively and correctly, but the low values that it was reporting had been covered up by a computer-program designed to discard sudden, large drops in ozone concentrations as "errors".[7]

It is not hard to design a system that works perfectly in a perfect world, but it is hard to design a system that works well in the context of technological and human error. In every important system, such as systems responsible for energy supply, or toxic measurements, there should therefore be fully redundant back-up systems, as well as planned-out alternative ways of solving the problem, including non-ICT solutions. Instead of trying to build a system that tries to be perfect, in most cases it is better to have a system that is slightly less efficient, but that is robust and can deal with a wide range of errors.

- Feedback mechanisms

A robust system must be built so as not to encourage a strengthening of positive feedback mechanisms.[8] Furthermore, it must be able to handle unforeseen inputs and treat them in a systematic way. As we can anticipate rapid and sudden changes in both ecological systems as well as in society over the coming years, there must be room for unexpected events in all large ICT systems.

- "Cradle to grave"

All systems and products must be designed with a "cradle to grave" perspective, whilst clearly disclosing what parameters are used and under what conditions they are supposed to work. In the ICT world, the speed of change is sometimes so rapid that many people forget that many structures will exist for a long time.[9]

- Conclusion

Whenever sustainable ICT solutions are implemented, no matter their nature, whether application, single product, or the ICT system as a whole, their functions must be optimised instead of maximised. As an ICT response to the precautionary principle, all solutions should be built around the concept of robustness.

4. Parallel time horizons

"They always say that time changes everything, but you actually have to change them yourself" *Andy Warhol*

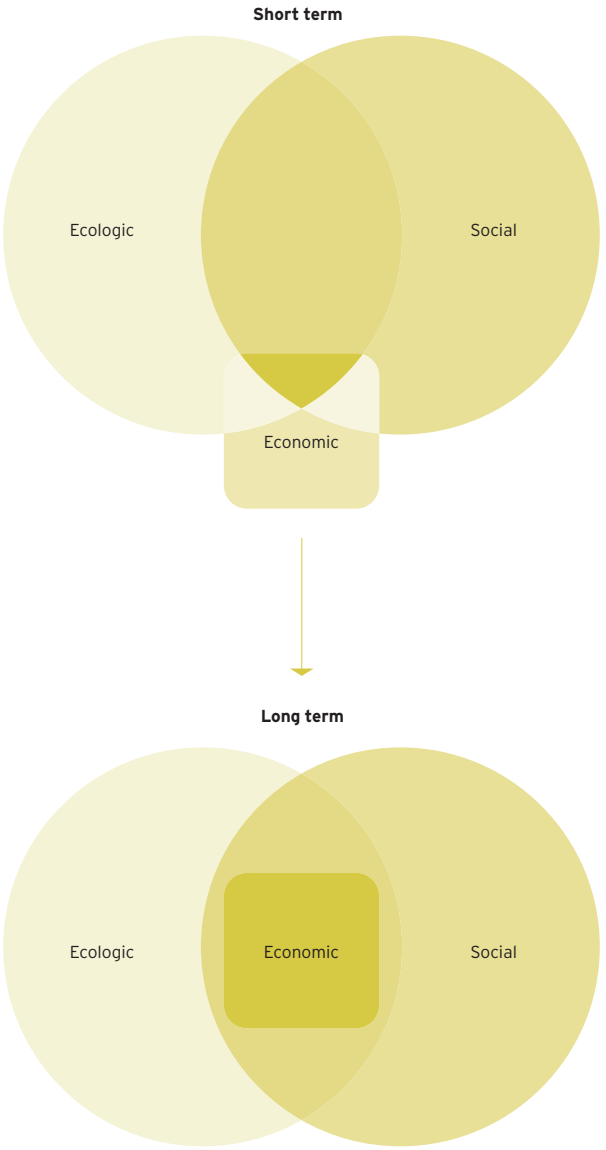
In a situation where the stock market reacts in seconds, new research indicates new environmental problems that need to be rapidly addressed, and fast technological change provides new opportunities and challenges every day, it is easy to feel confused. The scale of environmental and social problems is increasing, and the economy is moving faster; meaning that economic actors can introduce new products very fast and on a global scale, although these products can further contribute to the problems faced, instead of providing a solution.

In this chaotic situation, it is important to step back in order to have a clearer perspective on events. Since today's world is unsustainable, the important thing to discuss is not whether or not there is a potential "Armageddon" around the corner, but how to remedy the current situation.

Today, mankind is in the middle of a serious ongoing ecological catastrophe. Of course the situation could easily degrade further, but this should not de-emphasise that mankind is killing species at a record speed, whilst experimenting with the climate, releasing toxic chemicals, and exposing at every instant life on the planet to a myriad of threats, mostly due to humanity's own belligerent nature.

To solve these challenges, both damage control and actions with long term repercussions must be implemented. This could be managed by integrating the

use of parallel time horizons in all important sectors, with a significant environmental and social impact. Thus, short term actions would support long term goals.



- Short term

In the short term, the focus needs to be on two areas. First, the existing environmental problems need to be reduced as far as possible, with a thorough overhaul of the current system for damage control purposes.

Second, situations should be sought where there is a win-win-win situation – where economic, social and environmental goals are met. These windows of opportunity exist, and means of identifying them should be further developed than they are today.

The danger of a simple short term perspective is that it tends to neglect long term effects, and frequently results in attempts to make the best of an inherently unsustainable situation instead of contributing to a sustainable long term situation.

- Long term

By using the long term view, the perspective shifts. The existing situation is no longer taken for granted. Sustainability is often described as a balance between three different pillars, social, ecological and economic, with each needed, complementing the others and ensuring sustainability. From a short term perspective, this is a good enough definition, as it is obvious that all societies need all three pillars. However, from the long term perspective, it is important to realise the differences between the three.

The social pillar refers to the kind of society humanity dreams of and aspires to; one incorporating ethical values and goals agreed upon by the local and international community, with full importance given to human rights, equality, gender issues, etc. The ecological pillar can be similarly described, as incorporating values that reflect how humanity should affect the environment. This pillar therefore rests on the type of impact caused by humanity, and on the ethical aspect of this impact.

The economic pillar is, however, different, as it has no inherent ethical value. It can only be judged in respect of the other two. An economic system can only be sustainable when it exists within the carrying capacity of the planet and while it delivers social goals.

The very different nature of the three pillars, together with the currently dominant short term perspective, has resulted in confusion, where the long term flexibility of the economic system is often ignored. In order to shift from

an economy where the triple-win situation is hard to identify, and move towards a sustainable economy, attention must be focussed on strategic investments as well as on legal changes to the current system.

- Conclusion

In order to get away from a society that invests in systems that improve the situation on the margin, but lock the economy into a position that is ever further away from a sustainable society, the long term perspective needs to be included in all plans for the future. All major actors, including large corporations, governments and authorities should publicly disclose strategies that show how short term measures relate to long term goals.

III

III. STRATEGIC AREAS

Corporations, organisations and political parties are all very enthusiastic about ICT and its possibilities, but judging from the actual results so far, these ideas and thoughts are seldom transformed into concrete action. This lack of results often seems to stem from a lack of focus. Backed only by vague ideas, the process leading up to actual implementation often seems to wind to a halt somewhere before a concrete result has been achieved.

In an attempt to focus attention, this chapter will explore seven strategic areas where action must be taken immediately. These areas cover a wide span of issues and are all important, but in different ways. The areas chosen are, of course, not all that need to be addressed, but are among those that require rapid progress in order to ensure that ICT development will not contribute to the acceleration of the current negative trends, but will instead contribute towards sustainable development. If they are addressed in a successful way, ICTs chances to be used as a positive and useful tool for the future will have been considerably improved.

1. ICT products[10]

CHALLENGES:	OPPORTUNITIES:
Increased energy use and toxic substances in ICT products	Standards for appliances, information about energy usage and phaseout strategies

The importance of ICT products is due to two basic causes. First, even if ICT products themselves have only a marginal environmental impact, there is a

great risk that the political system and mass media will judge the whole sector as environmentally unfriendly if the sector as a whole does not have a clear environmental strategy. Thus, ICTs broader credibility is threatened.

Second, the rapid increase and penetration of ICT products can, if no action is taken, result in increased energy demand and bigger quantities of toxic substances. Even if these problems never reach the same magnitude as they have in other sectors, they must not be ignored as they have been so far. This would be easier with clearer targets for energy efficiency and phaseout strategies for toxic chemicals used in production.

In order to address the issue of sustainability, the sustainable approach must be integrated throughout the entire life cycle of every new product. Low energy use and the no use of toxic substances should be goals that are encouraged from R&D right through to the final act of recycling a product. In a networked society where hierarchies and responsibilities are often not so simple, combined with rapid technological development, central solutions cannot always be waited upon. Instead, each person involved in interaction with a product should be encouraged to improve sustainability performance.

Many ICT products themselves are very small, but they are numerous. In many cases they have significant ecological baggage, i.e. having created large amounts of waste from the creation of their basic materials through to their production. The cost of solving these problems are, however, small when compared to the over-all cost for most ICT products. The ICT sector could therefore play an important leading role when it comes to, energy efficiency, sustainable production and the use of non-toxic materials.

2. Transport of goods[11]

CHALLENGES:	OPPORTUNITIES:
Increased transport of goods	A shift from goods to service and optimised transportation systems

One area where ICT can contribute significantly in the short to medium term relates to the transport of goods. It is clear that ICT can be used to find more optimal transport routes and keep track of large fleets of vehicles. At first, this would appear to be positive contribution, but it could also result in further investment in a system that is inherently unsustainable. Due care must therefore be taken in order to avoid a situation where investments only result in marginal short term reductions and create an infrastructure that makes it hard

to reach the necessary long term solutions.

Physical transport of a product always results in environmental degradation. The biggest environmental challenge today in the field of transport is probably the use of fossil fuel, but even with sustainable energy sources, transportation will come with an environmental cost in terms of energy use and resource consumption. A second inherent problem with physical transport is land use. As soon as goods are moved, there is a renewed demand for space, both for the vehicles to travel on and for the storage of the products.

When considering a sustainable transportation system, it is important therefore to always think in terms of service. Is it possible to deliver the same service without a physical product? Can the Internet be used to transport a service instead of moving a product, to move bytes instead of atoms? This process, along with the encouragement of local production, could set in place a less ecologically damaging economy. Already some sectors have started a process towards a "smart cookie business", i.e. a business built around the concept of trading and exchanging "recipes", instead of actual "cookies" thus allowing the product to be made locally.

As there will always be a need for the transportation of some goods, there is a clear need to improve the quality of transportation. There is today a rough correlation between the level of environmental impact, and the speed with which goods are transported. This is rarely shown in the price of the product, nor is the environmental impact of the chosen way of transport. By introducing systems where the customer could choose the mode of transportation according to its environmental impact, there would be greater incentives for a sustainable transport system.

3. Business travels[12]

CHALLENGES:	OPPORTUNITIES:
Increased business travel	Video conferencing, development of virtual rooms, telecommuting

One strategic area where more advanced technology already exists, and where there could be a rapid and important shift towards sustainability, is business travel. Not only would a reduction in business travel result in significant environmental gains; but done in the right way it could also contribute to a corporate culture where physical transport would be an option to be avoided if possible.

The most important change needed in order to shift from a flying and car-

driving culture to a videoconferencing and telecommuting culture is a small mental and institutional shift. The culture today in many companies encourages business travel and the ownership of a car. High levels of travel reflect higher status in many sectors, and frequent flyers mileage is an extra bonus for many. In many countries, there are also tax incentives in place that encourage travel.

In order to address these challenges effectively, changes in routine must be started from the top. Company directors and those in high governmental positions must take the lead in asking for the best possible equipment both for telecommuting and virtual meetings. By getting these people involved, interest in a new way of thinking and working will spread fast, and further resources to implement the new structures will become available for less.

The reason to change modes of communication will never be environmental for most people. Even if the environment is an important factor, there will only be a significant shift the day a majority recognises that high-tech, high-resolution videoconferencing and telecommuting are better and more intelligent solutions than physical travel.

For this shift to take place, there must be no compromise solutions. Full-wall high-resolution projections for virtual meetings should be a standard in all major corporations, and all major cities should supply this kind of facility for groups and corporations that do not have sufficient in-house resources. The technology exists; it is just a matter of co-ordinated investments, as there would be little point in only one city or company investing in such technology.

There are more ways in which traditional business travel could be easily reduced. Through the increased possibilities of communication, many kinds of maintenance work could and can be carried out from any place that is connected to the Internet. The potential effect for the environment of this last would also be substantial, were it to result in a drop in the amount of physical travel.

4. Changes in production & consumption patterns[13]

CHALLENGES:	OPPORTUNITIES:
Increased material production and consumption	To reduce use of raw material and change of consumption patterns in a sustainable direction

Increased use of ICT would most certainly be an improvement to today's economy. Introducing ICT would make the economy more efficient in a number of ways; more accurate estimation of demand, the optimisation of production

processes and facilitated updates of products. However, very little indicates that these improvements, sometimes called eco-efficiency, would be sufficient to reduce over-all resource and energy use.

Efficiency gains so far have been balanced, in most cases, by increased production and consumption by those already consuming a disproportionately large share of the planets resources. If the existing pattern where mankind's ecological footprint is increasing and the differences in society are dramatically increasing is to change, perspectives must also change.

The first issue to be addressed is the very different economic and social situations on the planet. For the first time in history, a significant proportion of the world's population is living a life without material scarcity. At the same time, a much larger proportion is still living in poverty. By using the same development model for both systems, many of the negative trends seem to be accelerating instead of reversing.

Solving this challenge requires elaborating solutions for the more affluent parts of the globe to shift their economies from growth economies to quality economies, keeping sustainable development in focus instead of the old economic indicators. This transformation should take into account that the poorer parts of the world need basic goods and services, such as food, transportation, communication, medicine and housing. By shifting the research and production patterns in the more developed economies, a situation would be created which would facilitate a jump forward for the poor countries, over the resource-intensive industrial society, and straight into a post-industrial society with low environmental impact.

This shift in production should include a decentralised and flexible production system. This would enable intelligent and local solutions to meet most needs. The energy system is just one example where most rich countries today have a centralised large-scale system that is designed to deal with very large fluctuations. In a situation with a small-scale decentralised system, where it is possible to communicate between producer and consumer, there is no need to build the same kind of overcapacity, nor would it necessarily have to be based on fossil fuels.

From the customers' perspective, ICT could be used to find the product that is most environmentally friendly for the specific situation. This of course requires that companies make available information about the environmental performance of their products on the Internet.

As the amount of information freely available continues to increase, there

will be a need for tools that help to identify sustainable solutions, for example "intelligent agents"; programs that help to search for specific information on the Internet. By introducing environmental and social parameters, these agents could help users to find products and producers that supply sustainable solutions to different needs. If these agents could be tailor made to fit different needs, they could play an important part in increasing the level of sustainable development.

Although many new technical solutions will be created in the future, the most important development from a sustainable perceptive would be if ICT could contribute to a society that focussed less on people as consumers, and more on their role as citizens. ICT-systems should therefore encourage the distribution of free information, whilst being developed to leave room for dreams and visions.

5. Land use[14]

CHALLENGES:	OPPORTUNITIES:
Increased land use	Leapfrogging and strategic planning

Looking ahead, many of today's trends show that the exploitation of natural areas will continue. Resources required for the poor of the world, growing urban sprawl, increased transport, and the larger ecological footprints of more affluent societies all contribute to a situation where a minimal part of Nature is beyond immediate danger of exploitation.

In order to address this issue a multi-prong strategy is required, wherein ICT could play a significant role. Transportation and consumption have already been discussed, but there are many more gains that can be made in the field of sustainable land use.

First, ICT can help monitor land use in a more efficient manner than is currently the standard. Satellites and probes in remote areas can help to understand and identify different threats, such as illegal cutting of forests. Geographical Information Systems (GIS) may also be used to optimise land use in different areas.

Second, ICT can be used to communicate not only the threats to, but also the beauty of untouched areas. New technologies could be developed that would make it possible to follow life in remote areas from anywhere on the planet, which would improve personal identification with Nature and its values, such as those that exist in remote places like Antarctica, the coral reefs and the untouched rainforests.[15]

ICT can also be used for more direct educational purposes, such as calculating and communicating the footprints left by various lifestyles in different parts of the world. This helps to determine different ways of reducing society's ecological footprints, and aids the realisation that high quality life can be combined with a small footprint.

With ICT, strategies to align local, regional, national and international conservation work could also be further developed, which would make all of these far more effective on a global scale.

6. New technologies[16]

CHALLENGES:

Unanticipated problems when new technologies are introduced and merge

OPPORTUNITIES:

To integrate a sustainability approach in all parts of the production chain and start a process where the societal and political implications of emerging technologies are assessed

With ICT and genetically modified organisms (GMOs) already available, difficult ethical, environmental and economic questions beg to be discussed. Much indicates that ethical questions regarding new technologies will be even more important in the years to come, as there will probably be new breakthroughs in areas such as biotechnology, nanotechnology, robotics and quantum computing. If these technologies, and especially the combination of these technologies, are to be used in a responsible way, and if technological development is to contribute solving at least some of the challenges faced today, there is a clear need to approach the issue in a strategic way.

It is important to create incentives in order to direct development towards meeting the most basic and important needs of this planet. Today, whilst many products are developed only for the richest parts of society, this is partly due to the type of economic structures, including business models that have been created over time. These structures are often built around the idea of a large-scale production system, where the market consists only of a high or medium-income population. This system therefore tends to exclude many parts of the worlds population and ecology that really need the help of the newest technologies.

In order to direct ICT and broader technological development in a sustainable direction, independent agencies should be created on both the national

and international level to evaluate emerging technologies. One way to address this issue would be to develop an International Convention on New Technologies, to assess the societal and political implications of emerging technologies before their commercial release.

Due care must, however, be taken so as not to create a culture that believes that all problems may be solved thanks to technology.

7. Digital divide and digital bridge[17]

CHALLENGES:	OPPORTUNITIES:
Deeper digital divide, within and between countries	To increase the technological transfer, education and joint content development

Today a digital divide, both within and between countries, is growing. This divide is a serious issue, as it tends to increase already existing gaps, making the poor on this planet even more isolated than before. At the same time, most new ICT-technologies are built around new principles such as decentralisation and flexibility, all principles that make leapfrogging over stages of development easier.

Two things need to be taken into account when talking about the divide between those who have the technological resources, tools and the knowledge to generate and distribute information, and those who do not. First, the digital divide must be addressed together with the wider, and more classical economical divides. Far too often, attempts to bridge the digital divide are presented either as being in opposition to other development goals, or as the single solution to all problems. Neither of these approaches is particularly constructive.

To address this challenge, there must be a change in the methodology for addressing basic needs, acknowledging that it will be impossible for a purely commercial perspective to be used to close the digital divide.

Secondly, the cultural gap must also be bridged where the commercial values from one kind of culture dominate the design and development of large parts of the ICT system. There is an urgent need to develop strategies for the creation of cultural space and education for groups, so that the ICT system becomes a system built around diversity, wherein all different groups have their needs fulfilled.

CONCLUDING WORDS

A positive outcome for humanity and for the Earth depends on decisions made today. Before the end of the first decade of this third millennium, we will be able to see whether ICTs applications have come to be dominated by sustainability, or whether they are primarily driven by influential groups for their own short term benefit.

Throughout history, the consequences of mankind's actions have often been limited in time and space. The implications of many of our actions today are global, stretching far into the future; some of them, such as the extinction of species, are forever. ICT has brought into focus the opportunity to develop new innovative tools to address these challenges and opportunities. Used in the right way, ICT could also support the development of a global ethic, giving us information about the consequences of our actions, helping us to act according to our values, and creating a new kind of transparency where our physical footprints on the planet become visible for the rest of the world to see. This could create a new standard that would address the needs of the physical world through the medium existing in the virtual world. Thus, by merging the digital with the physical, the visionary with the concrete, the ethical with the practical, the long term with the short term, we could create a framework for sustainability at the speed of light.

We have the tools in front of us, we have the resources, and we understand the challenges and the opportunities. The question is whether a sufficient number of individuals that have the possibility to influence the development of ICT will dare to go beyond their current roles and have the courage to take innovative initiatives. The discussion about ICT and a sustainable development must continue, but we cannot wait any longer for the actions that could make it a reality.

FOOTNOTES

1 See for example the writings of Jean Baudrillard and Paul Virilio

2 One important ethical question that needs to be discussed in the context of democracy is personal integrity. An increased flow of information results in a number of challenges for personal privacy. The information distributed by ICT may be accessed by unauthorised parties with wide-based resources such as large corporations and states. Information in digital form can also be easily preserved for future access, raising further issues of privacy. As information collection may be carried out by computers and networks, individuals may not necessarily realise that their personal information has been monitored, logged, and subsequently disclosed. This issue may only be resolved through organised international co-operation, as well as through domestic organisation of such privacy issues. Thus, all major actors that collect information should develop strategies that protect the integrity of citizens and groups.

3 The same applies to the amount consumed by the average person in many of the world's richest countries, including Australia, Canada, United Kingdom, Czech Republic, Hong Kong, Switzerland, Saudi Arabia, Estonia, Sweden, Norway, Finland, Ireland, New Zealand, Denmark, Kuwait, Singapore and United Arab Emirates. The Ecological Footprint estimates a population's consumption of food, materials and energy in terms of the area of biologically productive land or sea required to produce those natural resources or, in the case of energy, to absorb the corresponding carbon dioxide emissions. The global Ecological Footprint increased by 50% between 1970 and 1997, a rise of about 1.5% per year. For more information see: www.panda.org/livingplanet/lpr00/

4 A Brave New World, 1932, by Aldous Huxley, describes a world where the state/corporation provides continual pleasure as a substitute for freedom. It is a society where people spend their entire lives in artificial pleasure. This involves continual consumption, participating in elaborate sports, and free-floating sex.

5 Shakespeare, -The Tempest, act I, scene ii

6 See: www.cisp.org/imp/november_2000/11_00matthews.htm.

7 www.nas.nasa.gov/About/Education/Ozone/history.html.

8 "Positive" feedback does not mean "good", it refers to a situation where the feedback reinforces or amplifies the initial change. Negative feedback is the opposite, and maintains stability by counteracting the initial change.

9 The Y2K problem was a good example of how a miscalculation of the lifespan can result in potentially large problems. The Y2K problem was born in the 1950s, when information storage was limited and expensive. To save time and money, programmers chose to indicate the year with only two digits. Computer scientists recognised this as a problem early on, but few believed that the technology of the 1960s would be in use by the year 2000.

10 For more information see the chapters "Environmental friendly ICT-products" and "The Internet and the new energy economy".

11 For more information see the chapters "The Internet and the new energy economy" and "E-commerce and the environment".

12 For more information see chapter "Can virtual meetings replace business travel?".

13 For more information see the chapters "Anticipations", "The Internet and the new energy economy" and " E-commerce and the environment".

14 For more information see the chapter "The Internet as conservation activist ".

15 For a good example see www.panda.org/polarbears/

16 For more information see the chapters "Anticipations" and "The Internet and the new energy
economy".

17 For more information see the chapters "ICT for development: Facing the policy challenges" and "The digital divide and beyond".

CONTRIBUTORS

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Romm, Joseph
is the executive director of the non-profit Center for Energy and Climate Solutions: a one-stop shop helping states and other organizations design strategies that save energy, increase reliability, and cut pollution. He is also a Principal with Capital E, LLC, which consults with companies in the area of clean, distributed, and reliable energy. For three years, Romm co managed and then ran the billion-dollar Office of Energy Efficiency and Renewable Energy at the U.S. Department of Energy, the largest program in the country for developing distributed energy technologies. Romm is author of the first book to benchmark corporate best practices in the use of energy efficiency, cogeneration, and renewables to reduce emissions: Cool Companies: How the Best Businesses Boost Profits and Productivity By Cutting Greenhouse Gas Emissions. He is also author of "The Internet Economy and Global Warming," which examines the current and future impact of e-commerce on energy use (available at www.energy andclimate.org).

Romm has lectured and written widely on business and environment issues, including articles in The Industry Standard, Forbes, Atlantic Monthly, Technology Review, Foreign Affairs, The New York Times, Washington Post, and Science magazine. He holds a Ph.D. in physics from M.I.T.

Levitt, James N.
is Director of the Internet and Conservation Project and a Fellow at the Taubman Center for State and Local Government at Harvard University's Kennedy School of Government. His research, educational and outreach effort focuses on how communications and transportation networks have enabled dramatic shifts in land use over the course of American history, and how a new generation of networks – exemplified by the Internet and express delivery systems – is enabling further changes in how and where Americans live, work, trade, learn, play and interact with nature. He is particularly interested in the potentially disruptive and constructive impacts of new networks on the conservation of land and biodiversity in the early 21st century. In association with this work, he has participated on panels for and made presentations to wide variety of groups, including the World Resources Institute, the National Governors' Association (US), the National Sci-

ence Foundation (US), the Harvard University Internet and Society Conference, the Yale Forest Forum, the University of Kansas Natural History Museum and Biodiversity Research Center, and the New England Forestry Foundation.

Prior to coming to the Harvard in 1998, Levitt worked as a management consultant, developing corporate strategy related to the emergence of the Internet and electronic commerce for Fortune-50 and large privately-held companies. He is active as a Director of several non-profit organizations, including the Massachusetts Audubon Society, the Quebec-Labrador Foundation and the Horizons Initiative. Levitt is a cum laude graduate, with distinction in Anthropology, of Yale College in New Haven, Connecticut. He holds a Masters in Public and Private Management from the Yale School of Management.

Cohen, Nevin
has focused on the issue of business and sustainability as an environmental planner and policy analyst for fifteen years, in government, academia, and in not-for-profit environmental organizations. For the past two years he has been researching and writing about the environmental and social effects of e-commerce and the Internet. He organized the first-ever international symposium on e-commerce and the environment with the Tellus Institute and New York Academy of Sciences. He is currently a consultant for the World Resources Institute's Digital Dividends project and is an associate of the Tellus institute, an environmental think tank. He teaches a course on the digital economy and sustainability at the New School University in New York City. Nevin Cohen has a Ph.D. in environmental planning, a Masters degree in city and regional planning, and a Bachelor's degree in economics.

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holds a MSc in Chemical Engineering and Technical Licentiate, is a senior researcher, lecturer and PhD candidate at the International Institute for Industrial Environmental Economics (IIIEE). Mr. Arnfalk has experience of conducting research and working with environmental issues in Sweden, as well as the U.S. and Japan. His licentiate dissertation: Information Technology in Pollution Prevention was presented and defended in 1999. He recently received an award from H. M. King Carl XVI Gustav of Sweden for his research.

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holds a degree in pure mathematics and economics of the University of Bonn (Germany). Before that he studied at the University of Halle/Wittenberg and the University of London. In 1998 he joined the Climate Policy Division of the Wuppertal Institute for Climate, Environment and Energy. Most of his fields of interest are directly related to international climate policy, with a special focus on economic instruments. In more recent times methodological questions of policy formulation and evaluation have occupied his attention.

Ott, Hermann E.
was trained as a professional lawyer and political scientist in Munich, London and Berlin. After working as an advocate in Berlin (mainly on environmental and criminal law), he joined the Wuppertal Institute for Climate, Environment and Energy in 1994. In 1998 he became Acting Head and in July 2001 Director of the Climate Policy Division. From November 2000 to June 2001 he served with Policy Planning of the German Foreign Office on foreign environmental policy. He works extensively on the legal, political and economic aspects of climate change as well as on other fields of international environmental protection

Dworak, Thomas
studied landscape planning at the University for Agricultural Sciences in Vienna, Austria and at the Swedish University of Agricultural Sciences (SLU) in Alnarp. In 2000 he joined the Climate Policy Division of the Wuppertal Institute for Climate, Environment and Energy. Among his interests are the environmental impacts of information and communication technologies and decision-making procedures in public administration, with a special focus on water management.

Zambrano, Raúl
the Senior Policy Advisor on Information and Communications Technologies for the Development, Bureau For Development Policy, Mr Zambrano has for the last 10 years worked extensively throughout 45 developing countries in Asia, Africa, the Caribbean, Europe, and Latin America. As Senior Advisor, Mr. Zambrano advises developing country governments and other partners on how to use and deploy ICT as an enabler for development, and to help them achieve specific development targets as set forth by the UN Millennium agenda in the year 2000. He is an active participant in the recent work of the G-8 DOT Force and the UN ICT Task Force.

As Project Manager for the UNDP Sustainable Development Networking Programme, Mr. Zambrano worked to assist developing countries in acquiring the capacity to access and contribute to solutions for sustainable development via the medium of ICT. He was responsible for Internet development, establishing local networks, NGO support, creation of local content in numerous languages, and substantial capacity building. Mr. Zambrano worked to establish early Internet Service Providers (ISPs) in a large number of countries, including Angola, Chad, Philippines, and Honduras. Several of these projects went on to commercialize their operations, remaining as a primary access point for networking within NGOs and Civil Society Organizations. Recent SDNP projects have focused on telemedicine, schoolnets, e-commerce and multi-purpose public access centers. Mr. Zambrano also actively worked to promote the open source movement and ICT awareness around the world. He is originally from Colombia, and is trained as an engineer, sociologist and economist with a major in economic development. Before joining UNDP in 1993, he worked in the academic sector in the US.

Afifi, Mona
is currently the Information Manager for the United Nations Capital Development Fund. She is also the Programme Associate for Sudan, the Gambia and Cape Verde, and is involved with the application of ICTs in the area of decentralisation and local governance. Ms. Afifi has 12 years experience in information management with strong knowledge of information and communication technologies and their relationship to development at the international level. She is a member of the Global Knowledge Partnership and the Internet Society, has been the President of the Staff Council of the United Nations Development Programme, the United Nations Office of Procurement Services and the United Nations Fund for Population, and represented staff both at HQs and the Field offices of 138 countries. As a change agent Ms. Afifi has been involved in two Change Management Processes for the United Nations Development Programme and was a full time member of the United Nations Development Programme Transition Team in 1999.

Ms. Afifi has recently contributed a chapter to 11 September 2001, when the World turned upside down, a White Book addressed in January 2002 to governments, international institutions, the media, world leaders, and academics. The Book addresses the development of the New Global Society after the terrible tragedy in the United States and the whole world, taking into account its unpre-

dictable consequences. Ms. Afifi's contribution aims at providing an understanding of how to act for a more human, equitable and peaceful global society, and also addresses the importance of girl's and women education and the digital divide. The White Book is a product of the Futuring the World Society (FWS) of which Ms. Afifi is a member.

Wijkman, Anders

is a Member of the European Parliament. He has been Secretary General of the Swedish Red Cross (1979-88), Secretary General of the Swedish Society for Nature Conservation (1989-91) and Director General of SAREC (1992-94). In 1995 he was appointed Assistant Secretary General of the United Nations and policy director of UNDP. From 1998 he has been Ambassador at the Swedish Foreign Ministry in Stockholm. He was elected to the European Parliament in June 1999.

He was a member of the Independent Commission on Population and Quality of Life (1993-95). In 1993-94 he chaired a special Swedish government task force to review Swedish foreign aid after UNCED. During the same period, he also chaired a government task force to analyse the consequences of membership of the European Union for the Swedish environment.

Mr Wijkman has specialised for the last decade and more in issues related to sustainable development. In the European Parliament he is active in the Committee on Development and Cooperation, and in the Committee on Industry, External Trade, Research and Energy. He has recently been one of the initiators of a cross-party initiative called Energy-Intelligent Europe, whose objective is to raise awareness about the huge potential for energy-savings that exist in European Union member states.

Mr Wijkman is a member of the Swedish Royal Academy of Sciences, the Club of Rome, the International Factor Ten Club and the International Academy of Arts and Science. He is the author of several books on disaster prevention, poverty diseases and sustainable development.

Lasn, Kalle

“I was born in Tallinn, Estonia, during the middle of World War II, and spent my early years in a German displaced persons' camp. When I was seven, my family immigrated to Australia, where I later earned a B.Sc. in pure and applied mathematics from the University of Adelaide. My first job was with the Australian Defense Department playing computer-simulated war games in the Pacific Ocean. On a trip to Europe to find my roots, my boat stopped over in Yokohama; I fell in love with Japan and was unable to get back on the boat. I started a market research company in Tokyo, made a lot of money, travelled the world, and finally returned to Japan to marry my wife. In 1970, we immigrated to Vancouver, Canada, where I started a film commune. Over the next 15 years, my experimental shorts and documentaries were broadcast on PBS, CBC and around the world, winning over 15 international awards.

In 1989, my work in film led to an epiphany. I produced a 30-second TV spot about the disappearing old-growth forests of the Pacific Northwest, and then discovered that no TV station would sell me any airtime. My subsequent projects, including The Media Foundation, Adbusters magazine, Powershift Advertising Agency and The Culture Jammer's Network, Buy Nothing Day, TV Turnoff Week, all stem from that moment's realization: that there is no democracy on the airwaves.”

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Finally Stefan Lindros, Tom Landfeldt and the rest of the team at Volt made a fantastic job in making the report both attractive and accessible.

RECOMMENDED READING

The web is of course the first reference and here are some pages to get you started:

www.cool-companies.org
www.digitaldivide.org
www.digitaldividend.org
www.digitaldividenetwork.org
www.digital-eu.org
www.dotforce.org
www.faw.uni-ulm.de/asis/html/fsummary.html
www.geog.ucl.ac.uk/casa/martin/atlas/atlas.html
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Books are a fantastic way of communicating and here are some of the best, challenging and/or most inspiring I used during this project:

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Speed of Light?