

# **IT and sustainable development**

## **- a central issue for the future**

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For every complex problem there is a solution that is  
simple, neat and wrong.

H.L. Mencken

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## Summary

The purpose of this report is to summarise and present strategic issues relating to ICT/IT and sustainable development. The report is based on discussions with various actors, including representatives of the industrial and academic sectors, media, authorities and ministries.

It was generally agreed that the Government should actively support the establishment of an efficient framework for gathering and supporting initiatives in which IT development contributes to sustainable development. An **efficient framework** is an essential prerequisite for a co-ordinated initiative under which different actors can collaborate to promote sustainable development in a focused, structured manner.

The first prerequisite for creating this type of framework is a **vision**. The second prerequisite is **resources**, both personal and monetary. The third prerequisite is **clearly defined responsibility**. Furthermore, the Government must be a **forerunner** of IT initiatives for sustainable development, particularly in the chosen priority areas. The fourth and final prerequisite is **focus and structure**. This report focuses particularly on this last prerequisite.

In order for a national initiative to have a clear focus, the work must be structured in a way that maintains an overall perspective and also focuses on concrete initiatives in which **measurable and communicable changes** can be achieved and reported. Furthermore, both positive and negative consequences should be analysed.

By structuring the work to incorporate general challenges as well as cutting-edge areas, IT development in Sweden can make a key contribution to sustainable development, both in Sweden and – to an even greater extent – internationally.

To illustrate how the work to promote sustainable development through IT could be organised in concrete terms, and how various initiatives could be gathered and co-ordinated, this report presents proposals put forward by various actors during the discussions. These proposals are divided into two categories: a structure for the overall work, and a structure comprising four strategic areas.

Three areas that should be studied and analysed over time are the general **cultural, democratic and economic changes** generated by the diffusion of IT. When facing such radical changes, it is vital to discuss the type of society and values generated by the development and implementation of IT, based on objective, up-to-date information.

Besides concrete goals, **four principles** could serve as a basis for integrating discussions on IT and sustainability in all organisations, both in the private and public sectors.

- 1. Shift the focus from products to services**
- 2. Include the issue of environmental benefits in all major IT investments**
- 3. Reduce rebound effects and calculate total gains**
- 4. Use parallel time horizons**

To prevent IT and sustainability from becoming empty catchwords, to give the work a focus point that allows many actors to build up their efforts, and to facilitate the communication of concrete results, a **limited number of focus areas** should be defined. These focus areas should be chosen and developed in collaboration with all the relevant actors. It is particularly important to include actors who have not traditionally made active contributions to sustainable development, and actors who have not defined their work as environmental management in the past, even if it produced environmental benefits.

There are several reasons why it is vital to **establish IT and sustainability** by focusing on a number of areas in which results can be achieved, instead of *exclusively* aiming to integrate IT aspects into all current environmental and sustainability initiatives. Firstly, this allows many actors who do not currently conduct environmental efforts **better opportunities for contributing to sustainable development**.

Secondly, IT is a branch of technology characterised by rapid development, both regarding hardware and software. It is vital for all IT development to focus on sustainability, rather than using a reactive approach where filters are created that eliminate or stop unwanted product and services. This is because the rapid rate of development makes **a reactive approach impossible**. But also because sustainable development should be driven by a positive rather than a negative approach.

Thirdly, a younger generation with strong environmental interest and technical expertise, and which is not yet established in specific professional fields, is entering the labour market. We must give this generation opportunities to contribute to sustainable development outside today's existing frameworks in order to capitalise on its innovativeness **and creativity** and spread a culture where environmental management is not seen as an isolated issue, but one that pervades all areas. Naturally, IT should also be integrated into current environmental efforts, and these two approaches to the challenge should be seen as complementary rather than conflicting.

**The chosen priority areas** should make up an integrated whole where both the individual elements and the overall work generate the following opportunities:

- produce significant environmental benefits and positive (or neutral) social and economic effects
- clear communication potential
- possibilities to establishing concrete goals
- significant business and export opportunities
- possibility for further independent development
- include the main areas concerned in the discussion on IT and sustainable development
- consist of a large, strategically important part of the population that works with these issues, and offer opportunities for creating new networks

Below are **four proposed areas** that were defined under the project *Forum IT och Miljö*. These areas were addressed to varying extents in the two workshops organised under the Forum. These four areas correspond fairly closely to the Government's earlier goals for initiatives involving IT and sustainable development, and further develop these goals. These categories could, of course, be defined differently, but some sort of structure is required to focus the work. The categories are:

- 1. Energy and environmental impact of the IT products themselves**
- 2. Transport and communication/Virtual mobility**
- 3. Community planning**
- 4. Production and consumption patterns**

Capitalising on IT development so that it contributes to sustainable development is an enormous challenge, and we must not underestimate the extent of the work ahead. However, the gravity of the situation makes it all the more imperative to promptly initiate structured efforts to utilise the existing opportunities.

## 1. Background

In 2001, the Government established a Forum for IT and environmental issues with a mandate lasting until December 2003.<sup>1</sup> The Forum's purpose was to provide a natural platform for information and communication technology (ICT) and ecologically sustainable development. The Forum is run by a work group comprising representatives of the industrial and research sectors, the Swedish Environmental Protection Agency (*Naturvårdsverket*), ministries and environmental organisations.<sup>2</sup>

The Swedish Environment Minister, Lena Sommestad, was appointed Chairperson of the Forum. The Forum's aim was to analyse how increased use can be made of IT applications to promote sustainable development, and how various actors can be encouraged to contribute to this goal. The group's mandate included studying ways in which IT use can contribute to the development of new infrastructures and products and services with lower resource consumption and environmental impact. The Environmental Protection Agency was responsible for the Forum's secretariat. The present document was written by Dennis Pamlin and Ewa Thorslund within the framework of the Forum.<sup>3</sup>

## 2. Purpose, procedures and limitations

The purpose of this report is to summarise and present strategic issues for, and the link between, ICT/IT and sustainable development.<sup>4</sup> The report is based on discussions with various actors, including representatives of the industrial and academic sectors, media, authorities and ministries. These actors were selected on a qualitative basis, meaning that individuals and groups were selected among central societal actors to represent as many different perspectives as possible.<sup>5</sup> The discussions were based on a document prepared in spring 2003 deriving from discussions held in the first year of the Forum.<sup>6</sup>

Many complex issues were addressed during the discussions. Which processes are at work in today's private and public sectors? What is happening in the research arena? What knowledge do we have? Are there areas that could be developed to boost Sweden's future export industry? What obstacles could prevent IT from contributing to sustainable development? etc. In all the discussions, we attempted to collect concrete suggestions. These suggestions have been structured and compiled in this document.

The document is divided into three sections on the basis of the discussions. The first section, Starting points, outlines the long-term trends and challenges to consider when developing a strategy for IT and sustainable development. The second section, A national initiative, presents a provisional framework for gathering and supporting initiatives where IT contributes to sustainable development. The third and final section, Focusing and structuring the work, presents a possible structure for the concrete work, which gives actors the opportunity to deliver actual results in a limited number of areas.

This report was produced with relatively limited resources, and its underlying information material depended on various actors being able to provide input and ideas without payment and at short notice. Consequently, this document does not purport to be an exhaustive study. Instead, it should be regarded as discussion material presenting some of the thoughts, ideas and suggestions that emerged during the process.

### 3. Starting points

The transition from an industrial to an information society gives us opportunities to go beyond marginal improvements and break the prevailing national and international trend towards increased environmental pollution and social gaps.<sup>7</sup> To achieve this, aspects such as IT applications and investments in IT infrastructure, which play a central role in this transition, must be viewed in a wider context. Only then can sustainable decisions be made in the transition from an industrial to an information society.

Today, IT has reached an interesting point. Previously, its development was largely technologically driven: “what can be done should be done”. Now, focus has shifted to the traditional economic aspects: “what increases profits and efficiency should be done”. So far, the central, long-term societal issues have taken second place. Issues such as what constitutes life quality, how to achieve long-term sustainable development and how technology affects our life and society’s general development still receive far too little attention in a political and industrial context.

If we consider our current situation, we can clearly see the need for a broader perspective focusing on what type of society we want. Sweden and the rest of the world are currently facing enormous challenges. Regardless of whether we take a medium-term perspective of 20 years or a long-term perspective of 50 years – a reasonable time span when talking about a new, extensive infrastructure – various development routes and challenges need to be included when working to ensure that IT promotes sustainable development:

#### - reduction in resource consumption

Rich countries, including Sweden, must significantly cut their resource consumption, in most cases by a factor of 4-10.<sup>8</sup> Carbon dioxide emissions, for instance, must be reduced by approximately 60-80%. One general challenge is to break the link between increased environmental pollution and economic development (known as *decoupling*) to allow fair, ecologically sustainable development on a global level.<sup>9</sup>

“The deep fault line that divides human society between the rich and the poor and **the ever-increasing gap between the developed and developing worlds** pose a major threat to global prosperity, security and stability. **The global environment continues to suffer.** Loss of biodiversity continues, fish stocks continue to be depleted, desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries more vulnerable, and air, water and marine pollution continue to rob millions of a decent life.”

World Summit on Sustainable Development,  
Johannesburg,  
September, 2002

#### - elimination of absolute and relative poverty

A large part of the world’s population still lives in poverty, and the situation is worsening in many parts of the world. Over 1.2 billion people, or a fifth of the global population, survive on less than 1 dollar a day, and 54 of 175 countries were poorer in 2000 than in 1990.<sup>10</sup>

#### - dealing with demographic change

Many rich and poor countries face a new demographic trend with a sharp increase in the elderly population, both in total and in relation to the overall population. New challenges will emerge at global level in roughly 50 years’ time, when the world’s population will have increased by three billion from today’s six billion to approximately nine billion.<sup>11</sup>

#### - dealing with present and future technological breakthroughs

Various technological breakthroughs are expected in areas such as bio-, materials and information technology. As these are interrelated, new opportunities and threats will emerge requiring international cooperation.

As regards the role of IT in the challenges listed above, it is important to remember the multi-faceted nature of this technology. Firstly, IT is a **threshold technology** that can quickly contribute to changing our societal and economic structures.

Secondly, IT often acts as a **catalyst** that can either accelerate today's negative trends or support the positive trends we see today. Although we do not know at present how IT will affect societal development, we do know that its impact will be significant and that decisions made today will determine the direction of societal development.

Thirdly, IT technology in itself is often of secondary importance. It is the benefits – the **applications and system solutions** – generated by IT that are of primary interest. These applications and solutions take many forms, and offer various benefits in a wide range of areas.

It is also important to remember that IT creates opportunities for new business logic. Various factors may contribute to this. In the future, for instance, instead of exchanging physical units, the intelligence could, in many cases, move into the networks. This could allow networks to be replaced and upgraded instead of physical products being replaced. Dematerialisation and new solutions could also lead industry to shift its focus from specific goods to services, in turn facilitating the transition to sustainable production and consumption patterns. The focus could be placed on meetings instead of plane trips, on energy services instead of energy production from non-renewable fuels, and so forth. Furthermore, as increased volumes of international data traffic enable different groups to report on international events, companies may be obliged to focus on externalities (unpriced effects), leading to the rewarding of environmental contributions and the minimisation of negative ones.

#### 4. A national initiative

Many groups and individuals agree that the Government should actively support the establishment of an efficient framework for gathering and supporting initiatives in which IT development contributes to sustainable development. Many see IT as a potentially powerful means through which developments in trade and industry can interact with and actively promote sustainable development. An efficient framework is an essential prerequisite for a co-ordinated initiative under which different actors can conduct focused, structured efforts to promote sustainable development. A possible content and structure for a co-ordinated initiative are presented below in section 5.

The first prerequisite for creating this framework is a **vision**. The Government should collaborate with other political parties, industry, researchers, NGOs, the public sector and other relevant actors to establish a clear, challenging vision. Without a clearly defined vision, it is hard to see why the Government is promoting the issue, and hard to gather and direct dispersed initiatives in a common direction. Furthermore, policies need a long-term perspective. This requires an agenda with concrete, easily comprehensible goals that the media and other actors can relate to, and which can generate debate – thus helping to spotlight the challenges we face.<sup>12</sup>

“American academic David Rejeski cautions against naive optimism. Environmental effects of ICT can be positive or negative, depending on a wide range of variables, he notes. Moreover, many of these variables may be hard to predict or to address. Where there are positive effects, such as eco-efficiency improvements, these often fall in the range of 5% to 20%, ‘not the factor 4 or 5 improvements that some have advocated (or hoped for) to deal with the increasing environmental burdens imposed by rapid growth in population and economic activity.’ Mr Rejeski concludes that **‘government policies and programmes may become a critical variable’** in determining the environmental implications of ICT.”

From Environment Daily 1433, 29 April 2003

For the vision to come alive, it must reach a wide audience, and should not merely focus on the technological and economic aspects of introducing sustainable development. Humans are cultural creatures, and technology and economy are simply tools for achieving the life and society we desire. However, the economic aspects should not be underestimated, as they are central driving forces.

A clear vision can also help make Sweden an international leader in the use of IT as an active tool for sustainable development. Using IT solutions that promote sustainable development will provide a strong boost to Swedish industry in general, and Swedish export in particular.

A problem we face today is that the overall picture is often ignored and that we lack integrated or actively co-ordinated environmental and industrial policies. As a result, the needs of many of the parties implementing the changes are often neglected, preventing successful results, and the debate on sustainability gets off to a negative start. It is particularly important to formulate visions that generate synergies between economy, environmental management and resource rationalisation, and to link these synergies to innovations and commercialisation (i.e. include an industrial policy-making perspective so that this area becomes a central force in the transition to sustainable development). Meanwhile, we must not forget areas that are difficult, impossible or unsuitable to commercialise. For this reason, the Government should encourage progressive companies to propose ways in which regulations can be changed to support sustainable development, and to discuss areas that the market cannot deal with and/or which should be kept outside the market.

The second prerequisite is **resources**, both personal and monetary. To allow utilisation of the existing potential, the effected initiatives must be steadily maintained and guaranteed for at least a five-year period. Although the major share of the work will occur in society, resources, particularly



from the Government and authorities, are important because they signal that this is a priority area. The role and specific conditions of small and medium-sized companies should be taken into account in the initiative. Although specific budgets need not be drawn up for the funding of IT-related projects for sustainable development, special allocations should be made for such projects within the framework of an organisation's budgets and strategies. The Government should encourage all relevant actors to report on how much they invest and how they work to combine IT development with sustainable development.

The third prerequisite is **clear responsibility** for IT and sustainable development. This is particularly important since IT-related issues intersect with many areas of policy-making that have not traditionally played a leading role in promoting sustainable development. Furthermore, the Government must be a **forerunner** of IT initiatives for sustainable development, particularly in the chosen priority areas.

The fourth and final prerequisite is **focus and structure**. In order for the vision to have a tangible content, a limited number of concrete areas must be defined. These focus areas must be defined through discussion and then clearly communicated to gain widespread support. These areas are of central importance, and must be chosen strategically to reinforce each other and encourage various synergy effects. Each area must have clear goals relating to the vision, and the goals must be followed up and evaluated. Without this type of focus, the concept of IT and sustainable development could easily be reduced to empty catchwords to which everyone pays lip service, while no concrete results are achieved.

## 5. Focusing and structuring the work

There are vast quantities of material discussing the implications of a transition from an industrial society to a knowledge society. The problem is that almost all material that looks at how to introduce sustainability can be divided into two categories that are not particularly conducive to our aims. The first category consists of generalised, visionary discussions on ways to dematerialise, reduce travel, curb resource consumption, change production and consumption patterns, etc. While this makes inspiring and interesting reading, it offers few concrete suggestions on what can actually be done and by whom.

The second category includes isolated, in-depth studies of narrow areas in which single technical applications are analysed in detail. This can provide valuable reference material for specific decisions, but without a broader analysis it only leads to marginal changes that are not linked to a general context in terms of time or space. Furthermore, isolated initiatives outside a general context can lead to counterproductive development binding us to unsustainable structures.

In order for a national initiative to have a clear focus, the work should be structured in a way that maintains an overall perspective, but also focuses on concrete initiatives where measurable and communicable changes can be achieved and reported. Furthermore, both positive and negative consequences should be analysed.

By structuring the work so that it incorporates both general challenges and cutting edge areas, IT development in Sweden can make a key contribution to sustainable development, both in Sweden and – to an even greater extent – internationally.

Listed below are proposals offered by various actors during the discussion process, suggesting concrete ways of working with IT to promote sustainable development. Section 5.1. presents a proposed overall work structure, and section 5.2. presents a proposed structure with four strategic areas. Under each heading, the concrete proposals are divided into the following subheadings:

- *Institutional changes.* This includes new services and institutions, changes in existing institutions and changes in working methods.<sup>13</sup>
- *Strategic research areas.*
- *Strategic changes in control instruments.* This includes the Government's ways of influencing society through taxes, laws, guidelines, etc.<sup>14</sup>
- *Strategic investments and initiatives.* This includes, for instance, public or public/private partnerships that supplement and support the efforts by companies and civilian society to find sustainable solutions.

### 5.1 General issues and principles

The transition from an industrial society to a knowledge society poses challenges that should not be underestimated. IT technology and IT solutions are being introduced at almost all levels of society, and our communication network is growing increasingly dense, powerful and multi-functional. The consequences of this development will affect our basic societal structures.

Three areas that should be studied and analysed over time are the general cultural, democratic and economic changes generated by the diffusion of IT. When addressing such radical changes, it is vital to discuss the type of society and values generated by the development and implementation of IT, based on objective, up-to-date information.<sup>15</sup>

As regards the cultural aspects, it is important to consider the values perpetuated by IT, and the way people perceive their own role in society. These are key issues when promoting sustainable development, not least because many of the values on which sustainable development is based go beyond the scope of today's market economy. If people do not have time for themselves, they are

unlikely to find time to protect the environment and the interests of future generations. If IT is to promote sustainable development, this development should not cause people to feel increasingly unhappy and stressed and to make rash decisions. Two areas that could be studied in this context are opportunities for people to find their own rhythm, and increasing people's perceived time margins.<sup>16</sup>

The development of major initiatives in projects, or more lasting structural investments in which IT is a central factor, should involve people whose perspective goes beyond economic and technical values. This is because it is important to discuss values that are often deprioritised, such as simplicity, slowness, silence, peace of mind, sharing, spirituality and inner and outer freedom.<sup>17</sup> Many people relate new IT initiatives to values such as these. Since very few people in Sweden are at risk of material deprivation, it is likely that more and more people will ask themselves whether technological development will favour or undermine this type of value.

From a democratic perspective, IT creates new conditions that both facilitate and obstruct participation. On the one hand, people have greater access to information and more opportunities to express their opinions. Yet on the other hand, it is more difficult to navigate the flow of information, and hasty decisions are often made. A more basic issue to consider is how democracy will be affected in a situation in which it becomes increasingly easy to find like-minded people while avoiding those who are not.<sup>18</sup> The crucial implications of IT are emphasised by the fact that leading security policy analysts are increasingly evaluating the future challenges posed by IT development.<sup>19</sup>

In order for IT to actively contribute to sustainable development, from an economic perspective, today's legal, economic and administrative frameworks must be extensively reviewed. Examining, for instance, which of today's laws and taxes are based on geographic and physical factors would open the way for a framework that supports an economy providing equivalent or better services with a fraction of today's resources. Issues such as whether a higher level of VAT should continue to be levied on e-books than on paper books, and whether investments in intelligent homes should be taxed on the same principles as company cars, should be discussed. Other more basic issues concerning ownership rights and pricing are linked to the question of how to encourage creativity and achieve prices that make sustainable IT solutions affordable for everyone on the planet.<sup>20</sup>

Institutions should integrate various aspects of IT and sustainable development at all levels, from appropriations letters and initiatives in which IT plays a central role in Sweden – for instance when the Government follows up the work of the IT Commission, and in the Regulatory Administration for Sustainable Development in the Cabinet Office – to international processes in which the future of IT is discussed, e.g. in connection with eEurope and WSIS.<sup>21</sup>

If the sustainability aspect is not integrated into forums in which the public feels that important issues and discussions take place, sustainability will never become more than a tag added at the end of a process after the crucial decisions have already been made. This type of reactive, ad hoc approach must not be tolerated, as it will probably lead to an acceleration of today's negative development.

In order for IT to contribute to sustainable development, the IT issue must be integrated both into current sustainability processes and into processes that affect IT development. Sustainability initiatives should focus particularly on processes that seek new ways of achieving sustainable development, for instance the EU IPP process, the ten-year framework programme for sustainable production and consumption patterns, the Global Public Goods initiative and the Millennium Goals.

Processes that affect IT development include national infrastructure planning, the EU TEN project, the structural fund programme, the eEurope strategy, WTO negotiations, etc.<sup>22</sup> (More work is probably required in this context, since these processes do not traditionally prioritise sustainability issues.) Meanwhile, we must not lose sight of the national perspective: increasing the competitiveness of Swedish industry is a fundamental prerequisite for securing and developing Swedish prosperity.

Besides formulating concrete goals for IT and sustainable development in relation to the above processes, the following four principles could serve as a basis for integrating discussions on IT and sustainability into all private and public sector organisations:

1. *Shift focus from products to services*

IT generates new solutions that allow previous needs to be met in completely new ways, and the new environmentally friendly solutions should be encouraged. Laws and taxes should be reviewed, both generally and in particularly relevant areas, since this change in perspective will cause the focus to shift from physical space and products to services and the web. An area that should be prioritised is public procurement, since strategic assistance could be a key instrument, particularly for the procurement of services. For instance, meeting service could be purchased instead of travel. This could mean replacing leasing cars with integrated solutions for flexible work comprising cars, car pools, home workplaces, video conferencing systems, etc. Naturally, the same type of solutions can be introduced by individual big companies, where innovative purchasing choices could significantly boost leading-edge markets.

2. *Highlight the environmental benefits of the use of all major IT investments*

Today's major IT-related initiatives (e.g. the 24-hour Authority (*24-timmarsmyndigheten*) and various IT-related services) include little or no integration of environmental issues. Similarly, when telephone and videoconferences are used, the participants are rarely made aware of the enormous environmental gains this type of solution offers. Actors should be encouraged or obliged to report the environmental gains – or losses – generated by different IT solutions, as well as various types of related repercussions. A study of how environmental information can be gathered, analysed and reported in various organisations should be prioritised as a preparatory step in implementing this measure.

3. *Reduce rebound effects and calculate total gains*

Finding completely new methods to meet needs often has both positive side effects and rebound effects (negative side effects).<sup>23</sup> While it is crucial to seek new solutions that dramatically reduce environmental impact, the environmental benefits of isolated efforts are often cancelled out by various indirect rebound effects. For instance, a transition to e-commerce could significantly reduce resource consumption, but this requires changes in transport systems, partial decentralisation of products, reduced consumption of physical products and increased use of experiential services. Without a comprehensive vision that co-ordinates various investments, control instruments and laws, the various improvements could lead to binding investments in suboptimised systems that do not promote sustainability. Consequently, a comprehensive, co-ordinated strategy combined with long-term research should be prioritised.

4. *Parallel time horizons*

IT often contributes to increased efficiency, faster decisions and faster product turnover. This frequently prevents long-term considerations from being prioritised. Finding ways of integrating various time horizons into decision-making at all levels will therefore be a central concern for both politicians and business owners.<sup>24</sup> For instance, the issue of long-term reductions in carbon dioxide emissions should be taken into account when deciding on measures to strengthen export. Similarly, the issue of long-term resource consumption and

emissions should be integrated into infrastructure planning. The political considerations when dealing with conflicting objectives should be clearly explained.

Reference material based on the above four principles could be prepared in collaboration with various actors, with experiences and effected measures being compiled in a way that is easy to overview.

<p><b>1. Institutional changes</b></p>	<ul style="list-style-type: none"> <li>- Having actors who set good examples is very important. For this reason, ministries and authorities responsible for IT and sustainable development should adopt an IT strategy for sustainable development that goes beyond the general guidelines.</li> <li>- In the Government's budget, the issue of IT and sustainability should be included and followed up.</li> <li>- Appropriations letters to authorities should urge authorities to openly report how they have used IT solutions to reduce environmental impact, and on the extent of their environmental impact (particularly with regard to transport and dematerialisation).</li> <li>- The issue of how to handle responsibility for sustainable development in relation to technical development should be prioritised in connection with future Government formation or reorganisation.</li> </ul>
<p><b>2. Strategic research areas</b></p>	<ul style="list-style-type: none"> <li>- Examine how IT can improve or impair life quality. Particular emphasis should be given to analysing conflicting views and finding optimum solutions.</li> <li>- Examine how new principles can be implemented across traditional sector divides. By studying if – and how well – the four principles described above have been integrated into various activities, a picture can be obtained of current obstructions and opportunities.</li> <li>- Monitor innovative collaborations between actors over time to determine which factors lead to success and which lead to failure. For instance, in connection with major projects, such as the BO projects, research groups could be linked to the continued processes stemming from the projects and support the established networks.</li> <li>- Investigate openings for passing from analysis to active measures in various organisations and activities.</li> </ul>
<p><b>3. Strategic changes in control instruments</b></p>	<ul style="list-style-type: none"> <li>- Integrate the issue of environmental impact into evaluations of all activities where IT plays, or could play, a central role. Projects linked to the 24-hour Authority, such as infrastructure investments, should be regarded as key areas in future.</li> <li>- Motivate companies that report their environmental impact, particularly those reporting indirect and systemic environmental impact (see Appendix 3). Monitoring the impact of activities is vital. It promotes identity and publicity.</li> <li>- Assess openings for introducing laws regarding basic sustainability audits.</li> </ul>

#### 4. Strategic investments and initiatives

- Various long-term initiatives should be conducted that explore long-term consequences for originators and users of new solutions. The various BO projects and Vinnova's ideas on Testbed Networks could play a central role here.

## 5.2 A limited number of focus areas

A limited number of focus areas should be defined to prevent IT and sustainability from becoming empty catchwords, to provide a focus point around which many actors can base their efforts, and to facilitate the communication of concrete results. These focus areas should be chosen and developed in collaboration with all the relevant actors. It is particularly important to include actors who have not traditionally made active contributions to sustainable development, and actors who have not tended to define their work as environmental management, even if it produced environmental benefits.

There are several reasons why it is vital to establish the issue of IT and sustainability by focusing on a number of areas where results can be achieved, rather than *only* seeking to integrate IT-related aspects into all current environmental and sustainability initiatives. Firstly, this would give many actors who do not currently participate in environmental efforts better opportunities to contribute to sustainable development. Secondly, IT is a technological area characterised by rapid development, both of hardware and software. It is vital for all IT development to focus on sustainability, rather than using a reactive approach where filters are created that eliminate or stop unwanted product and services. This is because the rapid rate of development makes **a reactive approach impossible**. But also because sustainable development should be driven by a positive rather than a negative approach. Thirdly, a younger generation with strong environmental interest and technical expertise, and which is not yet established in specific professional fields, is entering the labour market. This generation must be given opportunities to contribute to sustainable development beyond today's existing frameworks in order to capitalise on its innovativeness and creativity and spread a culture where environmental management is not seen as an isolated issue but one that pervades all areas. Naturally, IT should also be integrated into current environmental efforts, and these two approaches to the challenge should be seen as complementary rather than conflicting.

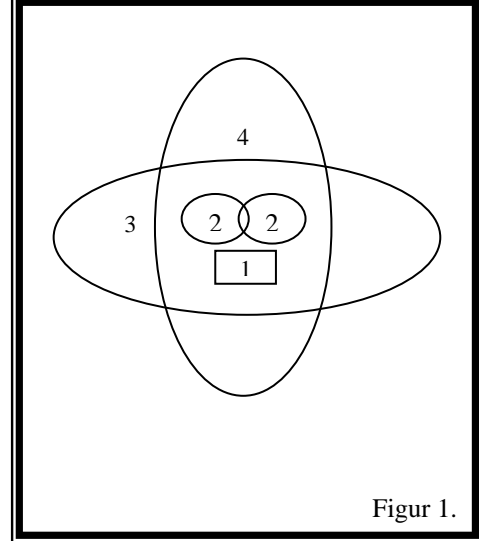
The chosen priority areas should make up an integrated whole where both the individual elements and the overall work generate the following opportunities:

- significant environmental benefits and positive (or neutral) social and economic effects
- clear communication potential
- possibilities to establishing concrete goals
- significant business and export opportunities
- possibility for further independent development
- include the main areas concerned in the discussion on IT and sustainable development
- consist of a large, strategically significant part of the population working with these issues, and provide opportunities for creating new networks

Below are four proposed areas that were defined during *Forum IT och Miljö*. These areas were discussed to varying extents in the two workshops organised in connection with the Forum.<sup>25</sup> The four proposed areas correspond fairly closely to the Government's previously established goals for initiatives involving IT and sustainable development, and further develop these goals.<sup>26</sup> The division into these categories could, of course, have been done differently, but some sort of structure is needed to focus the work. These categories are:

1. Energy and environmental impact of the IT products themselves
2. Transport and communication/Virtual mobility
3. Community planning
4. Production and consumption patterns

Naturally, the relationship between the different areas is complex and without clear-cut boundaries, partly due to their very different natures. Figure 1 illustrates the relationship between the different areas. Area 1. is concerned with the IT products, particularly the ones that people come into contact with. This area is vital to the credibility of IT solutions, since many people have difficulty taking sustainable IT solutions seriously if the products they need are not environmentally friendly. Area 2. is concerned with transport and communication solutions. The two intersecting circles represent the areas of goods transport and human transport. Areas 3. and 4. are the general areas of community planning and production/consumption patterns. All these areas are interrelated but have specific characteristics, which are described below.



Figur 1.

### 5.2.1 Energy and environmental impact of IT products

The IT products themselves do not have a direct, significant impact on society's energy consumption or the spreading of environmental toxins; it is mainly the applications deriving from these products that increase or decrease environmental impact. Despite this, there are two aspects that make it important to focus on the direct energy and environmental impact of IT products.

Firstly, IT products are multiplying rapidly and being integrated into a growing number of products. This means that IT products will play an increasingly important role from a sustainability perspective. Unless greater consideration is given to energy consumption and environmental impact when designing IT products and applications, their direct environmental impact could be significant.<sup>27</sup>

Secondly, in many cases, the products could provide users with clearer information on their environmental impact when used in various ways. For instance, printers could show each user how much paper has been used (in total and for each document), and the energy consumption of computers and monitors could be calculated at individual and company level to show saving potentials. Strategic public sector procurements and requirement specifications could increase the diffusion of this type of service. This would be easy to do, since many products would only require simple applications to calculate and show the results. Furthermore, experiments into the systematic use of IT to curb environmental impact are spreading rapidly. For instance, Tranås Municipality has introduced the Tranås Optimal Portal, where all the Municipality's products and services can be downloaded electronically, eliminating the need for paper. In Nacka Municipality, all municipal documents are distributed by regular post, while the appendices must be downloaded online.

The Swedish IT industry is well aware of the importance of reporting the direct environmental content of IT products. Furthermore, the Swedish IT industry actively contributes to the development and use of new ecofriendly materials. For instance, a standardised system for reporting on IT product content (the IT ECO Declaration) was introduced in Sweden in 1996. This system was designed and refined in close collaboration with major public and private sector purchasers.<sup>28</sup> This proactive initiative has attracted international attention. For instance, when the German counterpart to the Swedish Environmental Protection Agency commissioned a study to evaluate which environmental regulations should be imposed on the IT industry, it essentially copied the Swedish IT ECO Declaration. The collective European IT industry is formulating standards for improving the communication of the environmental content of products between manufacturers and suppliers on an international basis in collaboration with the US and Japan.



Sweden is also a forerunner in imposing demands concerning direct environmental impact when effecting public procurements. This has double benefits: it encourages the imposition of environmental demands in the IT industry, while it could also give the Swedish IT industry a competitive advantage when other countries start imposing the same demands. We should therefore study how the market's demands could be made stricter through collaboration between industry, authorities, politicians and NGOs.

As regards the direct environmental impact of IT, we should look into the possibility of funding R&D activities to reduce energy consumption and to phase out environmental toxins. Experience from Sweden should be used to aid the formulation of international standards. There also appears to be a need to support the development of systems providing feedback on the environmental impact of IT products and their functions early on in the design process. As a result, mobile phones, computers, monitors and software would have built-in systems providing information on their use and environmental impact to date, without compromising the products' integrity.

<b>1. Institutional changes</b>	- Clearer guidelines for the State's and public sector's use of energy-saving IT applications.
<b>2. Strategic research areas</b>	- Evaluate how to improve the energy-efficiency of whole systems, not just isolated parts of them. When purchasing a computer system, the combined function of its various parts should be evaluated. Buying energy-saving monitors but using equipment that requires them to be constantly running means suboptimising the system. This integrated perspective will become even more important as offices become increasingly mobile. It will prevent savings in one area being cancelled out by, for instance, unproductive travel.
<b>3. Strategic changes in control instruments</b>	- Assess opportunities for creating reward systems in organisations that buy and use energy-saving IT applications. - Continue the national and international process of establishing clear, long-term goals for phasing out environmentally harmful chemicals in close collaboration with industry, with harmonisation as a guiding principle.
<b>4. Strategic investments and initiatives</b>	- Major infrastructure initiatives such as 3G and broadband expansion should use renewable energy sources where possible. Decentralised energy production that can be exported to places without central electricity networks should be particularly encouraged.

**5.2.2 Transport and communication/Virtual mobility<sup>29</sup>**

One of the main environmental challenges is the growing need for transport. Increased use of land, noise, crowding and, not least, carbon dioxide emissions makes this area a major challenge, both in rich and poor countries.

Transport and communication can be divided into two categories: human transport and goods transport.

Flexible work forms and business trips are two areas of particular interest with regard to human mobility<sup>30</sup>. Four of the reasons for this are listed below:

- *The necessary technology already exists*
- *It is relatively easy to calculate environmental benefits*
- *Innovative control instruments can be used*

A possible tool for controlling work-related travel is emission right trading for work-related transport for Swedish actors. Emission rights could be zero-sum games, i.e. no increase in expenses. Another possible solution would be for companies and institutions to only have a

moral ceiling, but they would be obliged to report on the volume of their emissions and their efforts to decrease them.

- *Easy to set a good example*

Government stimulation of IT companies could make Sweden a global trendsetter. It could also lead to increased credibility in other areas. Public procurement could focus on services and functions rather than goods (i.e. communication/transport). Steps could be taken to encourage integrated communication solutions that make efficient, integrated use of telephone meetings, videoconferencing, web information, trains, cars and air travel. This could be done by centralising the responsibility for the service instead of dividing responsibility between different traditional areas. Companies that are major customers could encourage their suppliers to seek collaborations that would allow them to supply their services in this way.

Two approaches should be adopted with regard to human mobility. On the one hand, systems should be introduced that reduce environmental impact by rationalising the use of current systems, e.g. information on the fastest public transport solution sent to mobile phones, rationalisation of transport through positioning systems, real-time traffic information, etc. On the other hand, solutions should be created that minimise the need for physical transport, such as video and telephone conferences, telework, etc. Meanwhile, it is important to remember that today's industrial society depends largely on the availability of mobile workforces in the industrial and public sectors.

These two strategies – marginal and systemic – must always remain mutually supportive, never conflicting. Integrated solutions are often based on a combination of these two strategies. Increased use of videoconferencing, teleconferencing and home-based telework reduces the need for private car transport. This, in turn, can encourage the use of alternative solutions such as carpools. When the cars in the carpool are used, technology can be used to minimise travel, thus reducing emissions.

The movement of goods and services is an area where environmental impact can be reduced enormously. Increased economic activity often generates increased transport, and goods transport has significant environmental impact. The challenge here is to prevent marginal short-term profits from undermining the significant long-term profits that can be achieved through systemic changes. This area is particularly important because of its fast expansion rate.<sup>31</sup>

As regards marginal solutions, one way of making systems more efficient is by optimising logistics systems. Changes in work routines can also generate environmental benefits. For instance, Jämtland County Council now has a completely standardised system in which all employees have thin clients. When a terminal breaks down, instead of sending out service staff in private cars, a new product is sent directly to the relevant staff member by public bus.

Systemic solutions include dematerialisation – e.g. distributing information online instead of using physical media such as CDs and manuals – and decentralised production, where manufacturing instructions can be sent online to the production units instead of sending physical products.

One area that merits particular focus is product tagging, for instance using RFID, a technology that allows individual products to be tracked throughout their entire life cycle.<sup>32</sup> If sustainability aspects are integrated at an early stage, this technology could generate significant environmental benefits in connection with goods transport and logistics.

With the long geographic distances in Sweden, Swedish actors should investigate ways of creating competitive advantages from the long physical distances and evaluate whether the long transport distances have helped generate models that reduce physical transport needs. The installation of server parks in northern Sweden, for instance, could reduce the energy required for refrigeration,

while the Government could implement a programme using renewable energy to operate new servers in collaboration with relevant IT companies.

<p><b>1. Institutional changes</b></p>	<ul style="list-style-type: none"> <li>- Actors who currently focus on physical transport (including vehicles and roads) should consider changing to a service perspective.</li> <li>- Infrastructure projects should be integrated and compared in terms of the services they provide (e.g. road investments should be weighed against IT investments).</li> <li>- Public procurements should focus on services rather than products, so that companies and public administrations generate demand for solutions where flexible work, carpools and videoconferencing are integrated into the organisation. If demands can be set for environmental management systems, they can also be set for travel and communication policies.</li> <li>- The State should set a good example by creating flexible work solutions that have knock-on effects on private industry.</li> <li>- Evaluate the possibility of introducing a mobile parliament for Swedish MPs. The Swedish parliamentary systems will probably soon be reformed, and, if the will is there, Sweden could lead the world in certain areas (the world's first mobile parliamentary committee, the world's first mobile advisory group, committee work, etc.)</li> <li>- Explore opportunities for service and goods procurement that encourages optimised logistic systems and creates incentives for structural changes.</li> </ul>
<p><b>2. Strategic research areas</b></p>	<ul style="list-style-type: none"> <li>- Organisational structures that increase efficiency and generate opportunities for employees to perform their duties efficiently with minimum environmental impact.</li> <li>- Organisations should shift their focus from physical transport to services, for instance by appointing meeting managers instead of travel managers and procuring meeting- and work-related services instead of leasing cars.</li> <li>- Define areas where production can be decentralised given various incentive structures and technical innovations.</li> <li>- Ascertain how various regulations regarding delivery time affect emissions and how various infrastructure investments can minimise resource consumption and maximise efficiency.</li> <li>- Invest in research on intermodality and related technology for interfaces and standards.</li> </ul>
<p><b>3. Strategic changes in control instruments</b></p>	<ul style="list-style-type: none"> <li>- Deductions for home-based telework, incentives for actors who successfully introduce flexible work solutions.</li> <li>- Legal and informal requirements for board members and other groups to physically attend meetings.</li> <li>- Introduce regionally adapted emission limits and distribute emission rights for business travel (this could</li> </ul>

	<p>initially be implemented in public authorities). A similar, complementary system could be introduced for industry. Incentives for organisations achieving high scores.</p> <ul style="list-style-type: none"> <li>- Rules that allow hours worked during train travel to be paid (more than during air travel).</li> <li>- Introduce regulations for reporting on carbon dioxide emissions for goods and services. This would promote the use of IT for collecting and processing information, while customers, investors and citizens could use the information to guide their choices.</li> <li>- Look into possibilities for introducing parts of the Dutch system where travel schedules for car commuters have been changed (people are made to travel at different times). Companies that comply receive relief on payroll taxes.</li> </ul>
<p>4. Strategic investments and initiatives</p>	<ul style="list-style-type: none"> <li>- Use of new videoconferencing techniques in the Nordic Council (<i>Nordiska rådet</i>) (high resolution, full-wall projection, no half-hearted compromises).</li> <li>- Become a leader in the use of videoconferencing in various UN bodies.</li> <li>- Develop applications for measuring the carbon dioxide emissions and/or resource consumption of different goods and use the results as a factor when purchasing products.</li> <li>- Initiate discussion with trade union organisations regarding flexible work and work-related transport. This is particularly important in light of the predicted demographic changes in society.</li> <li>- Initiate an international meeting with the transport industry focusing on company car policies, involving actors with solutions that could reduce the overall need for cars. There is great potential here, as 40% of all new cars purchased in Sweden are company cars.</li> </ul>

### 5.2.3 Community planning<sup>33</sup>

Community planning comprises work at various levels, from traditional levels such as geographic regions, cities and city quarters all the way down to individual homes. All these levels must be approached with an integrated perspective. It is also vital that new areas based on IT use, such as the Swedish Testbed Networks discussed by Vinnova in the VINNITEL report, integrate sustainability aspects such as CO<sub>2</sub> emissions, resource consumption and sustainable export right from the planning stages.<sup>34</sup>

Community planning highlights the need for sustainability, not least because many investments in this context are intended to be used for many decades. Moreover, housing is a natural starting point for many people and an area where many of the decisions have significant environmental impact. Consequently, housing plays an important role in sustainability efforts, both in a symbolic and concrete sense.

Travel and communication, grocery shopping and domestic energy consumption are three central areas that can each be dealt with in different ways, depending on the time horizons chosen and the scope of the area to be studied and affected. The older population will grow progressively larger in Sweden and many other countries and this will generate new needs.<sup>35</sup>

Community planning also plays a key role in facilitating new solutions for minimising transport between the home and the workplace. Openness is required in order to relax the need for traditional boundaries such as work/home in a society with increasing mobility potential. However, the creation of opportunities for socialising outside the workplace will be vital if people increasingly choose – and are given the opportunity – to reduce their commuting to traditional workplaces.

To create opportunities for innovative thinking and new solutions, actors at municipal and county level should be encouraged to pioneer new system solutions, ideally in networks that extend beyond Sweden.

Finding new community planning and housing solutions often requires collaboration between a variety of actors. To prevent mistakes being repeated and to utilise proven solutions, various forms of support should be introduced for this type of pioneer network.

One of the main challenges with regard to energy-saving effects, in both homes and cities, lies in making products “converse with each other”, leading to what is variously termed as “pervasive computing”, “ubiquitous computing,” or “ambient computing.” These terms reflect a process in which we have gradually gone from referring to computer technology as “always present” to “present in places” and, finally, to “present as needed”. This evolution reflects an increasing focus on users’ needs above technology, something that will significantly affect production and consumption.<sup>36</sup> Communication between local home networks and, for instance, the heating system will generate energy savings by optimising energy consumption to the right times and methods. In order for this to be widely applied and have significant effects, technology and standards must be further developed in order to make the technology self-configuring (i.e. with simple communication and easy installation). Today’s technology lacks interfaces and a natural link to users, and is thus not user-friendly.

<b>1. Institutional changes</b>	<ul style="list-style-type: none"> <li>- When actors plan major infrastructure investments, e.g. ring roads and housing areas, needs could be prioritised and IT investments included.</li> <li>- The budgets of various organisations could focus on functions rather than products (for instance, a road budget could be replaced by a communication budget).</li> </ul>
<b>2. Strategic research areas</b>	<ul style="list-style-type: none"> <li>- Integrating traditional planning areas (cities, housing areas) with new planning areas (Testbed Networks) in environmentally friendly ways.</li> <li>- How people would like to live and how increased computer capacity (particularly if concealed/embedded) can contribute to environmentally friendly behaviour.</li> <li>- Study how new technology can show people the consequences of various choices.</li> </ul>
<b>3. Strategic changes in control instruments</b>	<ul style="list-style-type: none"> <li>- Intelligent housing projects must be supported, not undermined through higher expenses and cumbersome paperwork.</li> <li>- Change control instruments to prevent ecofriendly housing projects from being penalised through higher taxes and complex administrative procedures.</li> <li>- Set goals for institutions such as EIB and EKN for their work in areas where IT contributes to sustainable development.</li> <li>- Create incentives that encourage employers to give employees opportunities to work from home at least 1-2 days a week.</li> </ul>

#### 4. Strategic investments

- Major housing projects provide opportunities for including many aspects and finding new integrated solutions, particularly if conducted at several levels (geographic regions, cities, urban quarters, homes).
- Infrastructure that allows citizens to reduce physical commuting, e.g. through broadband networks and home telework facilities.
- Ensure that resources are available to support the pioneer networks during innovative projects after the projects are completed, to prevent this expertise being lost.

#### 5.2.4 Production and consumption patterns

The need for extensive changes in current production and consumption patterns has been increasingly highlighted in recent years. For instance, at the 2002 Johannesburg World Summit, a ten-year programme was adopted to evaluate how current production and consumption patterns need to be changed to become sustainable. Naturally, IT solutions must be included if this initiative is to make a significant contribution to sustainable development.

The question of how to make production and consumption patterns sustainable is not an easy one. Isolated measures can easily become counterproductive in a larger context. Consequently, more focus should be placed on discussing the wider effects of various goods and services on social development. A key issue for discussion is the “digital divide”, i.e. how to deal with differences within and between countries. It is important to remember that the digital divide is about more than just having access to technology. It is equally about having the necessary knowledge to use this technology, and about showing consideration for people who, in various ways, are averse to using certain applications.

One area in which the IT sector plays a doubly important role is in reporting how a company’s goods and services contribute to or undermine efforts to promote sustainable development. Firstly, the IT sector is the international leader in developing methods for reporting the effects – including indirect and systemic effects – of activities, (see Appendix 3). Today, the focus still tends to be placed on the direct effects of the production of individual companies, but if we are to introduce sustainable production and consumption patterns, it is vital to analyse the ways in which goods and services are used.

Secondly, IT solutions offer completely new methods for measuring the environmental impact of various production and consumption systems. Being able to track a product or service throughout its life cycle provides a better picture of its total impact.

Today’s environmental efforts largely involve the collection of data to be processed and presented in various contexts. Company reports and audits must be presented internally within the organisation as well as to authorities and to the market. Efficient use of IT facilitates both the introduction and maintenance of these environmental initiatives.

To promote sustainability, it is necessary to analyse where the profits lie and how to best achieve them. By getting products to “converse” with each other, it is possible to create early warning systems. This allows action to be taken at an early stage before problems escalate, for instance due to emissions. More importantly still, it prevents more complex problems arising due to many small, dispersed emissions.

Environmental informatics plays a central role in this context. Environmental informatics is a rapidly expanding area that includes various methods for collecting and presenting environmental data. In simple terms, environmental informatics is about analysing and presenting large volumes of information with the help of sensors, ID systems, real time systems, image analysis, etc.

The need to handle the vast amount of data that exists and is constantly being generated (volumes are estimated at 1-2 exabytes per year of unique data) will make data processing and interpretation a central concern in the future.<sup>37</sup> Studying how techniques such as XML can be used to collect data relating to the environment and sustainability in similar ways to those used today in the financial sector can contribute to choices being based on other criteria than just price.<sup>38</sup>

It is important to remember that in many cases, the necessary technology for creating sustainable IT solutions already exists. However, the IT industry is often unaware of users' sustainability needs, while users are unaware of the solutions IT can offer. This creates a gap in the IT industry. To bridge this gap, platforms must be created that allow various well-functioning examples to be presented and networks to be created.

As mentioned previously, incentive structures need to be reviewed, particularly in areas where the market does not give accurate price signals. The issue of profitability merits particular attention. This is because many of the production and consumption solutions offered by IT generate savings in society, yet it is hard for those making the investment to calculate the benefits.

Reductions in transport and resource consumption are usually noticeable when they occur within companies and authorities, but not when customers, subcontractors, citizens, etc. gain by them. A reduced need to travel or purchase new equipment, and increased leisure time benefit the environment and often helps promote prosperity. However, it is hard for companies and authorities to benefit from this. On the contrary, this type of change is often obstructed by short-term profit requirements.

<b>1. Institutional changes</b>	<ul style="list-style-type: none"><li>- Integrate environmental aspects into new initiatives (e.g. by evaluating various IT initiatives and showing citizens and/or consumers how various choices affect the environment).</li><li>- Demand information regarding the ecological footprints, resource content and toxins of products in connection with procurement.</li><li>- Create incentives for citizens (feedback, financial incentives and competitions).</li><li>- Companies and authorities should openly report their environmental impact and goals. If they lack the necessary methods and routines, these should be developed and implemented.</li><li>- Companies should be encouraged to develop and report business models that help reach groups that are isolated or lack resources, both locally and internationally.</li><li>- Authorities in Sweden and abroad should devise strategies for encouraging small-scale, decentralised technology.</li><li>- Evaluate possibilities for establishing a co-ordinating function to maximise export opportunities and the transfer of technology.</li></ul>
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## 2. Strategic research areas

- Opportunities for introducing sustainability in e-commerce. Opportunities for creating applications that measure consumption levels of individuals, and for introducing incentives for people with low consumption levels (this could be related to the material and results produced).
- Analyse where profits can be made from sustainable IT solutions, and whether systems can be created that allow societal gains to be transferred to the actors implementing the investments.
- Decentralised production. By studying technical and organisational opportunities for developing decentralised goods production, data can be collected that can help reduce emissions and other impact from transport, e.g. from roads.
- Modules for sustainability. By studying sustainable ways of developing production, modules can be developed for international use.
- Investigate the need for an Institute of Environmental Informatics.
- People's living situation in 20-50 years. The consequences of an experiential society with a new demographic structure.
- Product tagging. Opportunities for tracking goods and substances in society.

## 3. Strategic changes in control instruments

- Support actors who include environmental information when offering goods online. (Consumer choice is often confused by excessive information, and it is easy to resort to simple, short-term, price-based criteria. Sometimes consumers' choices do not even make long-term financial sense.)

## 4. Strategic investments and initiatives

- Development of applications that show citizens and employees the environmental impact of various choices, both directly and through the regular issue of information. For instance, it should be possible to see how various products have been used to date. Documents should have a function showing how many times they have been printed (this should be fairly simple to implement in companies and authorities, but more difficult with material passed on over the web). Evaluate the reasons for printing the documents (document layout, no access to laptop computers/reading while travelling, poor screens, accustomed to making notes on paper rather than on a computer, etc.).
- IT solutions for sustainable production and consumption patterns should be encouraged in connection with major investments and projects.



## 6. Conclusion

Capitalising on IT development so that it contributes to sustainable development is an enormous challenge, and we must not underestimate the extent of the work ahead. However, the gravity of the situation makes it all the more imperative to promptly initiate structured efforts to utilise the existing opportunities.

We noticed an enormously positive response while working on this document. There appear to be vast opportunities for creating new constellations and combining concrete work with visionary objectives. To prevent the energy and enthusiasm present in many groups from being wasted, a structured programme with a concrete content should promptly be initiated. This document presents a proposed strategy for putting words into action. Even if the discussion continues, it looks highly likely that 2004 will be the year when Sweden's work for IT and sustainable development really takes off.

*Where is the Life we have lost in living?  
Where is the wisdom we have lost in knowledge?  
Where is the knowledge we have lost in information?*  
T. S. Eliot's  
Choruses from the Rock (1934)



## **Appendix 1**

### **Discussion material**

**Forum IT-Miljö**

#### **Background**

Information technology is characterised by speed and a lack of boundaries. IT development affects us all and alters our life patterns. For a long time, the focus was primarily on the physical elements of IT development, such as computers, broadband technology and mobile technology. The focus is now shifting to the content of the various elements. This means that the issue of the contribution of IT to sustainable development will extend far beyond the direct environmental impact of IT products.

As a result, the key issue will become IT use and applications and their positive and negative environmental impact. As the information society evolves, the content of services and various applications, and the design of the systems, will determine whether IT obstructs or promotes sustainable development.

However, it is important to note that until now, despite its enormous positive potential, IT has primarily been used to rationalise current activities. Although this has frequently had positive environmental effects, these positive contributions have all too often failed to compensate for negative underlying trends.

“No overall positive trends can be depicted within the scope of the outlooks. For most of the issues there has either been insufficient progress towards recovery of a healthy environment, or unfavourable underlying developments... environmental action need to be integrated more closely into economic measures.”

Environment in the European Union at the Turn of the Century  
European Environment Agency, 1999

When evaluating how IT can go from making marginal contributions to sustainable development to really breaking the negative trends, a perspective should be adopted that spans a wide range of factors, from technical and economic to cultural and institutional.

Sweden's population has a high level of technical knowledge, a willingness to try new technology, and strong environmental awareness (both locally and globally). This gives us excellent prospects for becoming a global leader in IT development that promotes sustainability.

#### **Purpose**

To define and report on key strategic issues regarding ICT and sustainability. This will be done by preparing a brief document to be presented, in an initial version, to participants in all the workshops and they will have the opportunity to study it and make comments or amendments. After these comments and amendments have been added, a final version of the document will be submitted to the Forum. The purpose of Forum IT och Miljö is to help introduce the general issues in future workshops, so that the participants can discuss their individual areas in a broader context.

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#### **Procedure/project summary**

1. The project is based on various central investigation areas and initiative areas (see below).
2. On the basis of these areas, five small-scale brainstorming meetings will be held involving various groups of actors (including academics/researchers, industry representatives, representatives of authorities/public sector and business owners).

3. A document will be prepared based on comments from the above meetings; it is due for completion in May.
4. This document will be issued to the participants at the various workshops held within the framework of Forum IT och Miljö. The participants will be invited to make comments and amendments to the document.
5. The document will be adjusted on the basis of these comments and amendments and submitted to Forum IT och Miljö towards the end of 2003.

### **Investigation areas**

1. Development of applications for (Global) Public Goods.

This area includes areas in which the market gives inaccurate price signals or where the costs of individual actors make it difficult to implement applications for handling unpriced values (carbon dioxide emissions, significant cuts in resource consumption, etc.).

2. Interaction with other technologies

ICT often works as a catalyst. To promote sustainability, ICT must interact with other technologies. Which ones are they, and how do actors who work with them view the issue of ICT and sustainability? Particularly relevant technologies in this context are materials technology, miniaturisation, product tagging and nanotechnology.

3. ICT as a conveyor of information

ICT is largely about conveying and processing information. This function is likely to play a key role in the contribution of ICT to sustainable development. ICT can be used to communicate information in many contexts, from schools to research projects. What information is required, who can provide it, and how are we affected by spending increasing time in front of computers? These are all important discussion topics.

4. Infrastructure development

This area includes issues regarding the development of tomorrow's infrastructure. If ICT is to contribute to breaking the trend towards increasing transport, several things must be done. This requires a review of many elements, from decision-making structures through theories and education to routines.

5. Legal and economic issues

While ICT breaks down many traditional physical boundaries, it also creates new types of boundaries. However, our economic framework and laws are largely based on a society characterised by traditional physical boundaries. How will these laws affect the opportunities of ICT to promote sustainability?

6. Institutional issues

Many of today's institutions evolved during the industrialisation process. It is by no means clear how they should relate to ICT, and even less to the issue of ICT and sustainability. Meanwhile, new institutions are emerging that influence the development of applications, infrastructure investments, investment in and use of applications, etc.

### **Measures**

Identifying opportunities and obstacles can be complicated enough, but the real difficulty starts when suitable measures are to be defined. Yet concrete proposals are required in order to hold a discussion. It seems likely that measures will be needed in the following areas:

1. Strategic policy changes (e.g. laws, guidelines, taxes)
2. Major strategic investments (public or public/private partnerships that supplement and support efforts by companies and civilian society to find sustainable solutions)
3. Strategic research areas (in relation to international research and experiences in Sweden)
4. Institutional changes (new services/institutions, or changes in present and e-Government)

## Appendix 2

### Groups and individuals who participated in the process

#### Groups that participated in brainstorming meetings

- Representatives of industry
- Representatives of mass media
- Representatives of the public sector
- Representatives of the research community
- Representatives of the financial sector

#### Individuals who participated individually or in the above groups (in alphabetical order)

Robert H. Anderson, Senior Information Scientist and Head, Information Sciences Group, RAND  
Ingolf Berg, Swedish Ministry for Industry, Employment and Communications (*Näringsdepartementet*)  
Fredrik Billing, CEO, Dealflower  
Gunnar Bjurel, CEO, SICS  
Ulrik Brandén, founder of Soul Business Innovation and Head of IT panel, Teknisk Framsyn  
Linus Brohult, reporter, Mobil  
Urban Boije af Gennäs, Swedish Ministry of the Environment (*Miljödepartementet*)  
Paul Burrows, Manager, Nanoscience and Nanotechnology Initiative, Pacific Northwest National Laboratory  
Nevin Cohen, Managing Principal, GreenOrder  
Tore Davidsson, Environmental Co-ordinator, Teliasonera  
Joanna Dickinson, Project Manager, Transek  
Anna Green, doctoral student, Linköping University  
Gunnela Hahn, environmental and social analyst/asset management, Folksam  
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Petra Holgersson, Editor-in-Chief, Miljörapporten  
Anna Hrdlicka, researcher, Institute of Future Studies (*Institutet för Framtidsstudier*)  
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Maria Häll, political consultant, Swedish Ministry for Industry, Employment and Communications  
Per Johnsson, vicar, Borås  
Anja-Sofi Karhi, doctoral student, Linköping University  
Lotta Kempe, reporter, Computer Sweden  
Bo Kjellén, Chairman, Formas  
Eva-Lotta Löwstedt Lundell, Director, Swedish Agency for Administrative Development (*Statskontoret*)  
Monica Löwström, political consultant, Swedish Ministry of the Environment  
Göran Marklund, Chief Analyst, Vinnova  
Magnus Melander, Brainheart Capital  
Victor Olsson, reporter, TT  
Helene Richardsson, Swedish Federation of County Councils (*Landstingsförbundet*)  
David Rejeski, Foresight and Governance Project Director, Woodrow Wilson International Center for Scholars  
Hanna Roberts, Environmental Co-ordinator, BO-01  
Mihail Roco, Senior Advisor, National Science Foundation  
Joakim Skotheim, Swedish Environmental Protection Agency (*Naturvårdsverket*)  
Linda Sterner, Ministry Secretary, Swedish Ministry for Industry, Employment and Communications  
Bengt Svensson, Swedish Association of Local Authorities (*Svenska Kommunförbundet*)  
Charlotta Sörqvist, Swedish Ministry of the Environment  
Göran Uebel, Sustainable Development Unit, NUTEK  
Axel Wenblad, Director of Sustainability, Skanska  
Hans Wendschlag, Nordic Environmental Business Manager, HP  
Sture Öberg, CEO, ITPS  
Olov Östberg, Organisational Director, Swedish Agency for Administrative Development

### Appendix 3

#### GRI's guidelines for reporting direct, indirect and systemic effects by IT companies

The table below lists a range of direct, indirect and systemic effects resulting from the provision and use of telecommunications products and services. These examples and impacts are provided as helpful suggestions to illustrate the terminology used rather than mandate specific examples or applications.

Effect	Caused by	Examples	Impacts
Direct effects	Tele-communication infrastructure and products	Equipment such as the PC, mobile phones	Environmental and social implications from production, installation, maintenance and end-of-life-management Job creation in the telecom sector
		Communication infrastructure	
		Servers, routers etc.	
Indirect effects	Application by user of telecommunication products and services	E-commerce (B2B, B2C, C2C)	Environmental and social implications by alteration of existing products and service systems Environmental and social effects of new product and services Access to information Access to products and services Communities online Changes in work situations
		Private telephony or email communication	
		Telework	
		E-Government	
Systemic effects	A denser communication web, Changes in consumption pattern, new habits, synergy effects with other technologies	Change in consumption of goods and services	Changes in material flows Changes in energy consumption and green house gas emissions Land-use change Contribution to cultural homogeneity or cultural diversity Changes in civic culture Increased or decreased Digital Divide Changes in resource distribution
		Change in life style and work patterns	
		Increased information flows	
		Changes in existing economic and democratic systems	

Direct effects refer to the effects caused by the telecommunication infrastructure and equipment, e.g. the material consumption in producing mobile phones and Internet servers.

In-direct effects derive from existing use and habits that are fulfilled through communication-based applications. The reduced need for office space as a result of telework or the increase in just-in-time deliveries thanks to B2B applications are examples of secondary effects.

Systemic effects link performance at the micro-level (e.g., organisational level) with economic, environmental, or social conditions at the macro-level (e.g., regional, national, or global level). They stem from new habits, social structures and consumption patterns that arise through the use of communication products, applications and services when they are used in society, such as the change in commuting distances and times due to potential mobile communication, access to information and the speed of technological development.

Companies are encouraged to report on sector-wide projects in which they are involved that address the systemic effects of the application of telecommunications products and services.

<http://www.globalreporting.org/guidelines/sectors/telecom.asp>

## Footnotes

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<sup>1</sup> On 27 November 2003, the Government extended this mandate to 30 April 2004.

<sup>2</sup> For further information on the Forum, see <http://miljo.regeringen.se/Projekt/forum-it-miljo/index.htm>

<sup>3</sup> The authors prepared the report in a personal capacity, and the conclusions and views in it do not necessarily reflect those of the WWF or IT-Företagen. The discussion participants were also invited in a personal capacity to allow them freedom to offer suggestions independently of their employers (in the case of employees). The views and conclusions in this text do not purport to reflect individuals' opinions, and the participants in the meetings or discussions do not necessarily agree with or support the report's content. However, all participants were given the opportunity to read and comment on its content, in order to correct factual errors and suggest improvements.

<sup>4</sup> The concept *IT and sustainable development* combines two words that are in themselves complex and hard to define. Naturally, this means that they do not have a clear-cut relationship. In this text, the term *IT* denotes what is generally referred to as *information and communication technology*, shortened to *ICT*. This term covers far more than technology. It comprises a wide range of elements, from the modules that are linked together (mobile phones, computers, components in intelligent homes) to the infrastructure that enables their communication (copper lines, optical fibres, servers, satellites). More important still is the underlying architecture (e.g. web protocols) and the various network applications. As regards the technology, many previous boundaries will be challenged; the alternative term *IST* (Information Society Technology) is frequently used internationally. As regards sustainable development, we must avoid "pulling the carpet from under our feet", or from under the "feet" of future generations. In other words, we must avoid undermining the ecological systems that we need and choose to preserve, while at the same time creating social conditions where everyone can lead a fulfilling and dignified life. Thus, the issue of IT and sustainable development is about how ICT can help promote a society capable of creating favourable social conditions within its ecological parameters. Exactly what this entails can be discussed at length, but since many of today's trends (resource consumption, carbon dioxide emissions, environmental toxin emissions, etc.) are unsustainable, we must avoid becoming stuck in endless discussions. Instead, activities must immediately be initiated to break existing negative trends.

<sup>5</sup> Limited time and resources prevented us from meeting everyone we would have liked to have met. For a list of discussion participants, see Appendix 2.

<sup>6</sup> See Appendix 1.

<sup>7</sup> This has become even more crucial as studies are increasingly suggesting that IT does not, on the whole, contribute to sustainable development, but rather helps accelerate unsustainable trends. Although it is too early to draw definite conclusions, these studies indicate a need for collective measures. See, for example, "Cold water poured on IT's environmental pluses" in *Environment Daily* 1460, 11/06/03, <http://www.digital-eu.org>, Information technology benefits questioned *Environment Daily* 1433, 29/04/03, *Journal of Industrial Ecology* vol. 6, no. 2, Spring 2002 <http://mitpress.mit.edu/catalog/item/default.asp?sid=65CEA872-351E-4493-B6A5-DDD603AF3475&tttype=5&tid=1250>.

<sup>8</sup> At UNGASS, the UN follow-up meeting to the Rio Conference, held in New York in 1997, factor ten was recognised as a new environmental objective for all industrialised countries. The following excerpt comes from "Programme for the continued implementation of Agenda 2. Adopted at the General Assembly's extraordinary meeting on 23 - 27 June 1997, with Swedish comments" [http://www.agenda21forum.org/rappporter/fortsatta\\_genomforandet.htm](http://www.agenda21forum.org/rappporter/fortsatta_genomforandet.htm):

"Plans and strategies should be formulated to achieve changes in production and consumption patterns. These should be based, among other things, on resource efficiency, internalisation of environmental costs, financial control instruments, termination of environmentally harmful subsidies, the 'polluter pays' principle, producer responsibility, environmentally adapted public procurement, use of indicators for sustainable development, environmental labelling, improved environmental education and raised environmental awareness among the public. Governments

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should also consider implementing tax reforms. Rationalisation of material and energy consumption is vital. In this context, reference should be made to studies indicating a long-term need for industrialised countries to make energy and resource consumption ten times more efficient than today, and to improve their energy and resource efficiency by a factor of 4 within two to three decades.”

For further information on factors 4 and 10, see [http://www.wupperinst.org/FactorFour/FactorFour\\_links.html](http://www.wupperinst.org/FactorFour/FactorFour_links.html) and <http://www.factor10-institute.org/>

<sup>9</sup> Economic development and environmental pollution is a long-standing issue that comes into focus in discussions on IT and sustainable development. This is partly because IT can contribute to generating greater prosperity with fewer resources, but also because IT improves our opportunities for measuring prosperity, thus eliminating the need for aggregated measures such as BNP. For further information on decoupling, see <http://www.sou.gov.se/mvb/pdf/decoupling.pdf>

<sup>10</sup> “The world has never had such a wealth of resources and knowledge on how to combat poverty. Yet the 1990s was a decade of stagnation or retrogression in large parts of the world...54 of 175 countries were poorer in 2000 than in 1990 ... in 21 of them, the proportion of starving people had increased. In 14 of them, more children were dying before the age of five. In 12 of them, the number of children enrolled in basic education had dropped. In 34 countries, life expectancy had decreased. Such obstacles to survival were previously rare.” From Human Development Report 2003.

<sup>11</sup> On the global situation, see, for example, World Population Prospects: The 2002 Revision <http://www.un.org/esa/population/unpop.htm> On the situation in the OECD, see, for example, [www.oecd.org/oecd/pages/documentation/displayxml/0,3375,EN-document-0-nodirectorate-41311-0,00.html](http://www.oecd.org/oecd/pages/documentation/displayxml/0,3375,EN-document-0-nodirectorate-41311-0,00.html)

<http://www.oecd.org/EN/document/0,,EN-document-0-nodirectorate-no-4-41311-0,00.html>

<sup>12</sup> The first thing we should note with regard to establishing objectives is that IT can significantly improve opportunities for measuring and processing data.

For this reason, environmental and other objectives should be based on a mixture of existing objectives and new objectives to be developed. The following new objectives could supplement existing ones: reduce dioxide emissions by 40% before 2020 and by 80% before 2050, reduce total consumption of non-renewable resources in certain key areas by at least 30% before 2020 and 50% before 2050, reduce total consumption of renewable resources in certain key areas by at least 20% before 2020 and by 50% before 2050, etc. These objectives could subsequently be broken down to suit different areas and societal needs. Establishing clear environmental objectives allows indicators to be developed for various actors, in turn generating good opportunities for closely monitoring development. For a discussion on indicators, see

[http://www.oecd.org/department/0,2688,en\\_2649\\_34441\\_1779002\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/department/0,2688,en_2649_34441_1779002_1_1_1_1,00.html)

In the industrial sector, objectives should be established for export and industry structure. These objectives could include making X% of export IT-related export that directly promotes sustainable development, sales in the part of the sector that contributes to sustainable development in various areas, etc. For further discussion, see:

[http://www.oecd.org/department/0,2688,en\\_2649\\_33715\\_1773767\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/department/0,2688,en_2649_33715_1773767_1_1_1_1,00.html)

Social objectives are important, firstly because they show that we give central priority to people’s opportunities to lead a good life and that the work is undertaken with a positive spirit, and secondly because they ensure that the focus is kept on individuals and groups that actually risk being marginalised. This applies at all levels: local, national and global. The OECD has developed indicators that can be applied to results relating to IT development. See

[http://www.oecd.org/department/0,2688,en\\_2649\\_34637\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/department/0,2688,en_2649_34637_1_1_1_1,00.html)

<sup>13</sup> In common usage, the term *institution* is often treated as a synonym for *organisation*. In the present context, however, the authors wish to stress that *institution* comprises “the standards and rules that structure human action into permanent or recurrent behaviour patterns” (NE vol. 9 p.



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494). In other words, the term has a more basic meaning than *organisation*, which denotes “the organisational structure of a company or administration” (NE vol. 14 p. 480). Although the two terms are closely interrelated, in this text, we aim to highlight the importance of focusing on the more basic aspect when proposing changes at institutional or organisational level.

<sup>14</sup> The framework should be designed to both encourage forerunners and prevent stragglers. Forerunners are particularly important in the area of ICT. For further information on what proactive companies can do, see, for example, the WWF’s discussion on CSR <http://www.panda.org/downloads/policy/csrdiscussionwwffinal.doc>. However, the limitations of voluntary rules should also be considered, see, for example, the OECD report from 2003 <http://oecdpublications.gfi-nb.com/cgi-bin/OECDBookShop.storefront/EN/product/972003091P1>

<sup>15</sup> An issue for consideration in this context is the dilemma of the fragmentation in today’s research society. We know that specialisation is required to solve concrete challenges, but today’s divisions between various research areas are not always the most conducive to solving the problems we face today. Many different measures are required to improve this situation. Above all, the Government, research bodies, companies and other relevant actors should collaborate to clearly define problems that need to be solved.

<sup>16</sup> These two issues come from an article by Bodil Jönssons, Professor, Lund Institute of Technology, and Sture Nordhs, Chairman, TCO, in a debate in the *Dagens Nyheter* newspaper on 3 June 2003.

<http://www.dn.se/DNet/jsp/polopoly.jsp?d=572&a=147680>,

<sup>17</sup> These seven values derive from an unusual theme in an IT context: pilgrimages. This theme became topical in Sweden in connection with the 700<sup>th</sup> anniversary of the birth of Saint Brigit. For further information, see [www.pilgrimscentrum.org](http://www.pilgrimscentrum.org). These values can be compared or contrasted with those discussed by doctoral student Anja-Sofi Karhi in her article *Det kastade oket - om den allestädes närvarande datatekniken* (Throwing off the yoke – on the ubiquitous presence of computer technology), in which the author lists the following “views and basic values” that IT is both part of and a product of:

- Financial gain
- Technical development as a positive phenomenon
- Increased efficiency
- Monitoring and safety
- Tools and assistance
- Freedom

<sup>18</sup> For a discussion of ways in which various networks can undermine efforts to promote sustainable development by threatening democracy, see: “Networks and Netwars” by John Arquilla and David Ronfeldt (RAND).

<sup>19</sup> Listed below are some of the challenges that Robert Anderson, Senior Information Scientist, RAND sees in connection with IT development.

1. Cyber-anarchy. The increasing possibility of co-ordinated, simultaneous action by millions of people, worldwide, in response to some governmental activity. IT enables distributed, diffuse but co-ordinated activity by disgruntled persons.

2. Cyber-ghettoization, or cyber-Balkanization. IT enables persons to increasingly “drink their own bathwater”, confine their intellectual pursuits to a small community of like-minded persons who mutually reinforce each other. Rather than reading newspapers or “network” television, they congregate at web sites, chat rooms, newsgroups that reinforce their prejudices, and therefore increasingly believe that their views are commonly held.

3. Dumbing down of society. There is a real possibility that generations raised on video games, “chat rooms” and TV are less educated and have shorter attention spans. A short attention span makes it hard to understand complex issues such as climate change, poverty and endocrine disruptors. This might be true even if similar charges have been levelled against the “next generation” since Socrates.

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4. IT as a magnifier of the gulf between “haves and “have-nots”. The life and infrastructure in the OECD is so different from lives in areas such as the sub-Saharan Africa and Bangladesh that there is a risk that these regions will never catch up and enjoy anything like comparable power to affect their lives. The western world is leaping ahead in IT infrastructure so far that the gulf is widening, and will continue to do so even when certain parts of IT becomes a cheap commodity, and they can by cellphones etc.

This list summarises some of the areas highlighted in a discussion with Dennis Pamlin at RAND’s offices in Santa Monica, CA on 9 June 2003. The points are simplified, and are not reported verbatim.

<sup>20</sup> For a discussion of creativity and patents/ownership rights, see Lawrence Lessig, “The Future of Ideas – The Fate of the Commons in a Connected World”. For an alternative perspective on rules for a new economy, see Kevin Kelly, “New Rules for the New Economy”.

<sup>21</sup> eEurope: [http://europa.eu.int/information\\_society/eeurope/index\\_en.htm](http://europa.eu.int/information_society/eeurope/index_en.htm)

WSIS: <http://www.itu.int/wsis/>

<sup>22</sup> Various projects are under way, but many European projects are linked to DG-infosoc and EU research programmes. For a list of interesting projects, see [www.cordis.lu/ist/results](http://www.cordis.lu/ist/results).

<sup>23</sup> Rebound effects are caused by unexpected negative consequences of IT solutions, such as **direct, indirect and systemic effects** (for a summary of various types of consequences, see Appendix 3). For a general discussion of rebound effects, see [http://www.iiee.lu.se/ercp/workshops/docs/10\\_rebound\\_summary.pdf](http://www.iiee.lu.se/ercp/workshops/docs/10_rebound_summary.pdf)

<sup>24</sup> The challenge regards not only the time aspect, but also how fast changes occur, and in what way. It appears that many problems have to exceed a certain pace of change before becoming issues of political debate. See, for example, the article “S&T Challenges in the 21st Century: Strategy and Tempo” by David W. Rejeski.

<sup>25</sup> For information on the workshops, see <http://miljo.regeringen.se/Projekt/forum-it-miljo/index.htm>

<sup>26</sup> THE GOVERNMENT STRUCTURE:

The Swedish Government bill *Ett informationssambälle för alla* (An information society for everyone) (prop. 1999/2000:86) states that IT policies should promote sustainable development by, among other things:

1. using IT to promote ecologically sustainable development,
2. using IT to reduce the environmental and health impact of transport,
3. including IT equipment in a sustainable cycle

THIS DOCUMENT’S STRUCTURE:

1. Energy and environmental impact of the IT products themselves
2. Transport and communication
3. Community planning
4. Production and consumption patterns

The Government’s point 1. corresponds to points 3. and 4 in the structure used in this document. We have chosen to focus on two major areas where IT needs to be integrated in order to significantly contribute to sustainable development. It is in these areas that significant and radical changes can be made. It should also be stressed that IT can only very rarely be used to significantly reduce environmental impact in existing systems. In most cases, larger systems need to integrate IT for sustainable development purposes right at the planning stages. The Government’s point 2. corresponds to our point 2., but to avoid focusing exclusively on current transport, we wish to stress the importance of thinking ahead and including future transport systems, and, of looking beyond traditional transport systems and considering communication needs. Finally, we agree that the environmental impact of the IT products themselves needs to be addressed, and the Government’s point 3. corresponds to our point 1. However, we also wish to clearly highlight the issue of energy consumption.

<sup>27</sup> For further information, see e.g. <http://enduse.lbl.gov/Projects/InfoTech.html> and <http://www.digital-eu.org/publications/default.asp?pubid=43>

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<sup>28</sup> <http://www.itecodeclaration.org/>

<sup>29</sup> Virtual mobility was the theme of a workshop held in early June 2003. The documentation from this workshop is available at <http://miljo.regeringen.se/Projekt/forum-it-miljo/index.htm>. Several of the recommendations listed in this section were addressed in detail at this workshop.

<sup>30</sup> Further reading on flexible work is available from SUSTEL, a two-year EU research programme studying e-work and sustainability:

<http://www.sustel.org/> This site also contains a list of links to related projects:

[http://www.sustel.org/european\\_ist\\_projects.htm](http://www.sustel.org/european_ist_projects.htm)

For further information on e-commerce see, for example:

<http://www.sustainit.org/programmes/ebusiness/ebusiness.htm> and <http://www.digital-eu.org/>

<sup>31</sup> Last year, e-commerce in the US increased by 48% to 76 billion dollars. This year, online trade is expected to increase by a further 26% to 96 billion dollars. 32% of software and computer sales occurred online. Online ticket sales for theatres, concerts, sport events, etc. are increasing, and now represent 17% of total sales. 12% of book sales in the US occurred online. Source: *Dagens Industri* newspaper, 19 May 2003 (citing a study by Forrester Research and Shop.org).

<sup>32</sup> Product tagging entails individual labelling of products or product parts, so that they can be identified remotely. One technique used is RFID (Radio Frequency Identification), which is defined by the RFID Journal as follows: “A method of identifying unique items using radio waves. Typically, a reader communicates with a tag, which holds digital information in a microchip. But there are chipless forms of RFID tags that use material to reflect back a portion of the radio waves beamed at them.” For further information, see <http://www.rfidjournal.com/>

<sup>33</sup> A workshop was held in October with the theme *The intelligent city – IT and the environment in transport and building*. The documentation from this workshop is available at <http://miljo.regeringen.se/Projekt/forum-it-miljo/index.htm>. Several of the recommendations listed in this section were thoroughly addressed in this workshop.

<sup>34</sup> <http://www.vinnova.se/uppdrag/vinnitel/vinnitel.pdf>

<sup>35</sup> Use of technology to “improve” human performance will become increasingly sophisticated, and sustainability aspects are not always given a central role. For an interesting example of a research project that will receive generous funding, see “Converging Technologies for Improving Human Performance – Nanotechnology, Biotechnology, Information Technology and Cognitive Science” by Mihail C. Roco and William Sims Bainbridge (ed.).

<sup>36</sup> For a discussion of consequences of more integrated computer use, see:

[http://wwics.si.edu/index.cfm?fuseaction=news.item&news\\_id=27725](http://wwics.si.edu/index.cfm?fuseaction=news.item&news_id=27725)

<sup>37</sup> These figures on data volume come from Lyman, Peter and Hal R. Varian, “How Much Information”, 2000. From <http://www.sims.berkeley.edu/how-much-info> 2 June 2003.

<sup>38</sup> For instance, a system called XBRL has been introduced in the financial sector. Companies use this system to publish relevant financial information on the web according to certain rules. This allows analysts to constantly access the latest information and compare different actors on the basis of the latest information. Using a similar system for environmental data would allow consumers to easily compare the environmental impact of different companies and products when making purchases, something that has been suggested by GeSI. Extensive analysis is required today to define the environmental impact of various companies, and the data supplied by individual companies is often incompatible. For further information on XML, see, for example, <http://www.w3.org/XML/> and <http://www.xml.org/> For further information on XBRL, see, for example, <http://www.xml.org/>