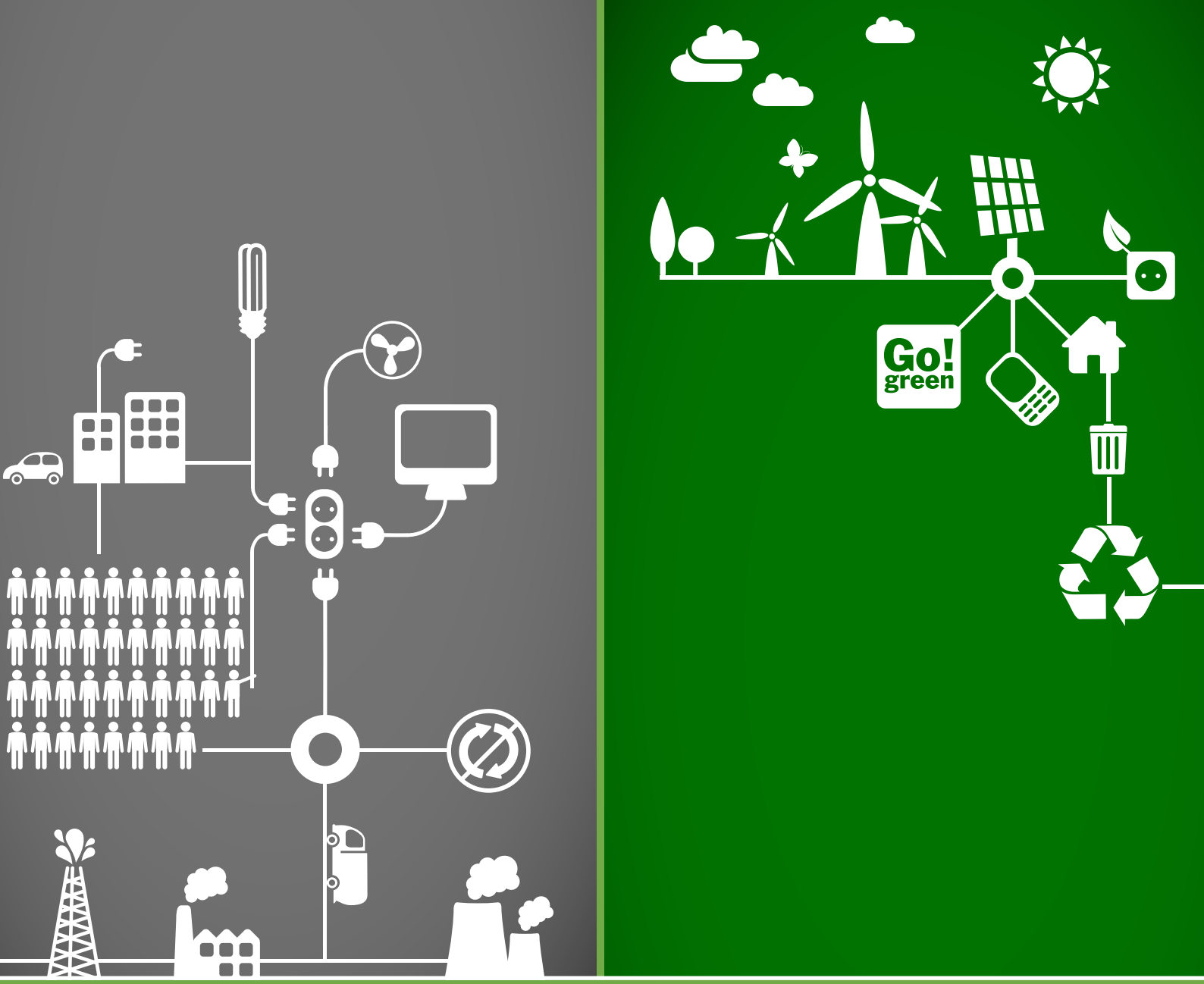

Toolkit on environmental sustainability for the ICT sector

Executive summary

itu.int/ITU-T/climatechange/ess

Acknowledgements

This toolkit was developed by ITU-T with over 50 organizations and ICT companies to establish environmental sustainability requirements for the ICT sector. This toolkit provides ICT organizations with a checklist of sustainability requirements; guiding them in efforts to improve their eco-efficiency, and ensuring fair and transparent sustainability reporting.

The toolkit deals with the following aspects of environmental sustainability in ICT organizations: sustainable buildings, sustainable ICT, sustainable products and services, end-of-life management for ICT equipment, general specifications and an assessment framework for environmental impacts of the ICT sector.

The authors would like to thank Jyoti Banerjee (Fronesys) and Cristina Bueti (ITU) who gave up their time to coordinate all comments received and edit the toolkit.

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Additional information including the full list of contributory organizations can be found at: www.itu.int/ITUT/climatechange/ess/index.html

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Toolkit on environmental sustainability for the ICT sector

Executive summary

The Smart 2020 report found that the full life cycle carbon footprint of the ICT industry represents around 2% of worldwide emissions, and is projected to grow at a 6% annual compound growth rate. Although the sector's emissions are rising, its largest influence is expected to be through enabling increased energy efficiencies and improved environmental performance in other sectors.

A significant challenge for ICT companies is that in enabling better environmental performance elsewhere, the ICT sector is itself taking on significant burdens, at a time when there is greater scrutiny applied to environmental performance, and, often, at much greater cost. As a result, it is important for ICT organizations to use sustainability actions to drive their own business performance, while being more responsible corporate citizens.

The Toolkit on Environmental Sustainability for the ICT sector is an ITU-T initiative which provides plenty of detailed support on how ICT companies can build sustainability into the operations and management of their organizations, through the practical application of international standards and guidelines.

The basic components of the toolkit are a number of individual documents, each covering a separate area, as follows:

- *Introduction to the toolkit*
- *Sustainable ICT in corporate organizations*, focusing on the main sustainability issues that companies face in using ICT products and services in their own organizations across three main ICT areas: data centers, desktop infrastructure and telecommunications networks.
- *Sustainable products*, where the aim is to build sustainable products through the use of environmentally-conscious design principles and practices, covering development and manufacture, through to end-of-life treatment.
- *Sustainable buildings*, which focuses on the application of sustainability management to buildings through the stages of construction, lifetime use and de-commissioning, as ICT companies build and operate facilities that can demand large amounts of energy and material use in all phases of the life cycle.
- *End-of-life management (EOL)*, covering the various EOL stages (and their accompanying legislation) and provides support in creating a framework for environmentally-sound management of EOL ICT equipment.
- *General specifications and key performance indicators*, with a focus on the matching environmental KPIs to an organization's specific business strategy targets, and the construction of standardized processes to make sure the KPI data is as useful as possible to management.
- *Assessment framework for environmental impacts*, explores how the various standards and guidelines can be mapped so that an organization can create a sustainability framework that is relevant to their own business objectives and desired sustainability performance.

Each document features a discussion of the topic, including standards, guidelines and methodologies that are available, and a check list that assists the sustainability practitioner make sure they are not missing out anything important.

Although the toolkit is wide-ranging and designed to help improve business *and* sustainability performance, some companies may decide that they cannot afford to use such tools, particularly in the light of a negative business outlook. This document explores why companies cannot ignore their sustainability performance if they seek superior financial performance.

Finally, the document covers how the toolkit may mature and develop in future, through extending its scope, deepening its metrics, lowering the questionnaire burden on ICT companies, and through the provision of an implementation program to enable national regulators, policy-makers and individual ICT organizations to use the toolkit to achieve their own objectives.

1 Introduction

If a CEO's pronouncements were all the evidence we needed that a business was doing something, then sustainability would be top of the strategy charts.

Over half of the McKinsey Global Survey 2010[1] participants consider sustainability – the management of environmental, social and governance issues "important" or "extremely important" to their businesses. An even more optimistic Accenture study[2] of 766 CEOs found 81% claiming that sustainability is part of the strategy and operations of their businesses.

In practice, for most companies, word and deed diverge.

The same McKinsey study reports that most companies are not actively managing sustainability, or seeking opportunities for such investments or making it part of their business practice. Yet, the best sustainability performers comfortably beat their competitors on sheer economic grounds.

If anything, information and communications technology (ICT)[3] companies should pay even closer attention to sustainability than companies of many other sectors. The Smart 2020 report[4] confirmed that the full life cycle carbon footprint of the ICT industry represents around 2% of worldwide emissions, and that ICT footprint is projected to grow under business-as-usual (bau) conditions at a 6% compound annual growth rate to 1.4 GTonnes of CO_2 by 2020. At such rates, the ICT industry's footprint would comfortably exceed that of a sector such as airlines.

Although its own emissions[5] are rising, ICT's largest influence is expected to be through enabling increased energy efficiencies and energy use reductions in other sectors. In this context, the Smart 2020 report also found that the scale of this ICT-enabled opportunity was found to be a massive 7.8 GTonnes of CO_2 by 2020, equivalent to 15% of all emissions under bau projection.

A significant challenge for ICT companies is that in enabling all this environmental efficiency in other sectors the ICT sector is itself taking on significant burdens. For example, as companies migrate from on-premises software applications systems (where all the systems run on their own hardware, powered by their own energy, etc.) to cloud-based systems (where the cloud service provider provides the server hardware and pays for data centers, energy, backup, etc.), the ICT provider takes on a greater burden of environmental impacts (and costs) in the new model compared to the old one.

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1 McKinsey Global Survey Results: How companies manage sustainability, McKinsey, 2010, https://www.mckinseyquarterly.com/Strategy/Strategy_in_Practice/How_companies_manage_sustainability_McKinsey_Global_Survey_results__2558.

2 Lacy, P., Cooper, T., Hayward, R., Neuberger, L., A new era of sustainability, Accenture, 2010, www.accenture.com/us-en/Pages/insight-new-era-sustainability-summary.aspx.

3 On the definition of "ICT", ISO/IEC Joint Technical Committee (JTC) – 1 N 9475 developed the clarification of the term ICT: "ICT includes the specification, design and development, integration and interoperability of systems, tools and applications dealing with the capture, representation, accessibility, processing, security, transfer, interchange, presentation, management, organization, storage and retrieval of information, and their related cultural, linguistic adaptability and societal aspects."

4 SMART 2020: Enabling the low carbon economy in the information age, The Climate Group, 2008, www.smart2020.org/publications/.

5 An organization is responsible for greenhouse gas (GHG) emissions in a number of ways, either directly by burning fuel or processing chemicals, or indirectly by purchasing energy from other sources. ICT companies need to be aware of where and how their emissions are counted. This should then drive their emission reduction strategies, against which they should be accountable through their sustainability reporting. See Annex.

Yet, for many companies, managing sustainability[6] performance is often seen to be a "good" thing for a company to do, even the "right" thing, but not necessarily a business driver for success. Word and deed are still separated.

So how do companies get their deeds to match their words? And why should they bother? Both questions need to be answered so that ICT companies can get their sustainability actions to drive business performance inside their own organizations and in their customers, and help them be more responsible corporate citizens.

2 The components of the Toolkit on environmental sustainability

The Toolkit on environmental sustainability for ICT companies is an ITU-T initiative, carried out together with over 50 partners, which provides plenty of detailed support on how ICT companies can build sustainability into the operations and management of their organizations. It puts international standards and guidelines into context and brings them to life with real-life examples, showing how ICT organizations around the world are dealing with their sustainability challenges.

The toolkit covers a range of sustainability issues that impact the performance of an ICT organization. While much of the material is focused for use by an ICT organization, the pervasiveness of ICT does mean that all sorts of end-user organizations can also benefit from the material in the toolkit, as they manage the in-use aspects of ICT sustainability.

The basic components of the toolkit are a number of individual documents, each covering a separate area, as follows:

- sustainable ICT in corporate organizations;
- sustainable products;
- sustainable buildings;
- End-of-life management;
- general specifications and key performance indicators;
- assessment framework for environmental impacts.

2.1 Sustainable ICT in corporate organizations

This document focuses on the main sustainability issues that companies face in using ICT products and services in their own organizations across four main ICT areas: data centers, desktop infrastructure, broadcasting services and telecommunications networks.

Historically, data center managers only focused on maximizing their computing performance and expanding the availability of IT resources. Today, the rate of increase of data processing has outpaced the center's

[6] On the definition of "sustainability", ISO 14021 states, "The concepts involved in sustainability are highly complex and still under study. At this time there are no definitive methods for measuring sustainability or confirming its accomplishment. Therefore, no claim of achieving sustainability shall be made." Currently, "sustainability" has been used as an umbrella term for all of human activity to meet current needs without hindering the ability to meet the needs of future generations in terms of economic, environmental and social challenges. Sustainability may be defined as a means of configuring civilization and human activity so that society and its members are able to meet their needs and express their greatest potential in the present while preserving biodiversity and natural ecosystems, and planning and acting for the ability to maintain these ideals indefinitely. Sustainability is a general term that states a visionary goal for a sustainable society of human beings. Every business and technology sector can do appropriate actions within its scope and capabilities to improve on its own measure of sustainability and, most importantly, to improve the measure of sustainability for other sectors.

ability to support such systems. As a result, environmental factors such as energy and water have become the main limiting factor in the data center environment – as strong a business reason as possible to focus the attention of management on sustainability. This document covers a number of IT efficiency and utilization metrics that data center managers can use to enhance their business and sustainability performance.

The management of desktop infrastructure is just as important inside ICT companies as it is with user organizations, since most of the energy consumed by IT equipment is wasted, mostly because computers are on with no one using them. Not only do the computers waste energy, they also create an indirect impact by heating their surroundings and causing a greater load on air-conditioning, for example. This document covers best practices on desktop infrastructure, use of alternative data management techniques, and the use of software to measure and manage the environmental performance of desktop infrastructure.

Telecoms network infrastructure and devices are responsible for over a third of the ICT industry's greenhouse gas emissions. Thanks to new technologies and energy-efficient products, the energy usage per device is improving. This document outlines a number of different metrics that can be used in managing power utilization in a network, plus it covers codes of conduct and policies that help manage the sustainability impact of network infrastructure.

Similar issues face the broadcasting services industry, where energy is a key consideration in an industry which uses bright lights, huge audio and video files, and many different types of networks. This document explores best practices in delivering such services, and the metrics that can be used by broadcasting services organizations to deliver a combination of desktop infrastructure, data centers, telecommunications network, broadcast infrastructure and customer in-use energy management.

2.2 Sustainable products

One of the best ways for the ICT industry to provide its customers with more sustainable products is to build them from the start using environmentally-conscious design principles and based practices, covering development and manufacture, through to end-of-life treatment. The document provides design assistance with two categories of products: network infrastructure equipment and customer premise equipment.

Product design needs to cover five "Green Focal Areas" in order to create sustainable products: energy, product weight, packaging, hazardous substances and recyclability. Customers can use green programs and initiatives, such as US EPA Green Star, EPEAT, RoHS and so on, to ensure that the ICT products they buy meet the environmental standards laid out in such programs, while designers need to ensure that the standards are adhered to in their products.

This document also discusses how life cycle assessment (LCA) methodologies, such as ITU-T methodologies to assess the environmental impact of ICT, can assist designers in directly evaluating the environmental impacts of a product or its sub-assemblies.

2.3 Sustainable buildings

Across Europe and the US, buildings are the largest driver for both energy use and CO_2 emissions, with European buildings contributing 40% of energy use and emissions, and US buildings accounting for 48% of the corresponding number.

ICT companies build and operate facilities that can demand large amounts of energy and material use in all phases of the life cycle. This document applies sustainability management to buildings through the stages of construction, lifetime use and de-commissioning. The use of standards, methodologies and tools, such as LEED, Green Globes and BREEAM, is discussed, as is the use of life cycle assessment to evaluate actual performance of buildings, as opposed to buying into certain prescribed practices.

2.4 End-of-life management

The growing volumes of end-of-life (EOL) and near end-of-life ICT equipment around the world is becoming a matter of concern. The failure of close the loop on e-waste leads not only to significant adverse environmental impacts, but also to the systematic depletion of the resource base of secondary equipment.

When equipment no longer satisfies the original user's needs, we should not assume that it is in poor operational condition, or has become obsolete. Instead, it may be possible to extend its life through use for the same purposes by other users. Or, it can be re-used (in part or whole) for other purposes, or the materials contained within it can be recycled or recovered.

This document outlines the various EOL stages (and accompanying legislation), and provides support in creating a framework for environmentally-sound management of EOL ICT equipment.

2.5 General specifications and key performance indicators

While the ICT industry plays an important role in enabling organizations of other sectors to improve their sustainability performance, the sector's own negative environmental impacts continue to rise. The industry needs excellent procedures and processes to deal with environmental data to improve its sustainability tracking, management and performance.

This document focuses on environmental KPIs that can be used by an ICT organization to quantify and evaluate performance in this area. There are already a number of standards and methodologies in place that can be the basis of just such a management system. What this document does is identify how to choose KPIs that relate to specific business strategy targets the organization has. It then explores how to build standardized processes with KPIs to make the data as useful as possible to management. It then covers how to ensure that the right data is collected, and once collected, is verified and validated.

2.6 Assessment framework for environmental impacts

There are a number of standards and guidelines that have been created by standards organizations regarding the management of energy, GHG emissions and waste, from the perspective of ICT products, projects and organizations. This document maps all the standards and guidelines across two dimensions:

- assessment targets, including product, organization, project, city or country; and
- assessment criteria, including inventory, carbon footprint, life cycle assessment, ICT enablement accounting, product eco-design, labelling, and validation/verification.

The resulting mapping of the standards uses these dimensions to explore their application, their inter-dependencies, complementarities, and so on. As a consequence, organizations can use the various standards and guidelines to create their own sustainability assessment framework.

3 Business drivers for sustainability performance

Although the Toolkit on sustainability for the ICT sector is wide-ranging and is designed to help improve business *and* sustainability performance, some companies may decide that they cannot afford to use such tools, particularly in the light of a negative global business outlook.

The problem with such a perspective is that sustainability performance and business performance are so closely tied together. This next section explores reasons why companies cannot ignore their sustainability performance if they seek superior financial performance.

3.1 The best sustainability performers are the best performers. Period.

Accenture's study of 275 global Fortune 1 000 companies [7] analysing business and sustainability performance metrics shows that the top 50 companies ranked on sustainability outperform the bottom 50 by 16% when it comes to shareholder returns over a three year period.

Over five years, the results are even more skewed in favour of the best sustainability performers: the top 50 outperform the bottom 50 and middle 50 peers by 38% and 21%, respectively.

So the best sustainability performers make more money. Of course, it is not clear which is cause and which is effect here, but it's still a great reason to get involved in sustainability.

3.2 Operating efficiency is a sustainability virtue

One important factor driving economic performance is resource efficiency. As companies deal with depletion of resources, environmental impacts, and materials security, they seek new and improved ways of doing what they do, often driven by ICT enablement. The consequence of this is improved performance inside the business, and improved ability on the part of the company to transition into the low-carbon world that is already being shaped into place.

Resource efficiency is also an area where it's very important to be forward looking. According to World Wildlife Fund,[8] the world economy took as much as the planet can offer (in terms of natural resources and as a sink for our waste, including global warming gases) in 1988. Since then, we have been borrowing from future generations and, as economies continue to grow, so does our deficit with nature. Many are predicting a crunch in the natural world as devastating as the financial credit crunch experienced in 2008. It's unlikely to happen as quickly as the financial crises, but businesses should be building it into their long term-cost forecasts.

In many ways, the recent price hikes in energy, commodities and food are all linked to long-term sustainability related trends, and are an early indication of the internalization of many externalized costs that are currently unaccounted for.

3.3 Keeping out of regulatory trouble is a sustainability driver

It is clear the world's economies have done a poor job of preserving the planet's natural resource amenities, such as air fresh water, and carbon. As a result, most Organization for Economic Co-operation and Development (OECD)-based businesses have had to pay for some of the pollution they cause.

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7 Berthon, B., Abood, D.J., and Lacy, P., Can business do well by doing good?, Accenture, 2010, www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Outlook_Can_Business_Do_Well_by_Doing_Good_Sustainability.pdf.

8 www.wwf.org.uk/what_we_do/about_us/building_a_one_planet_future.cfm.

Historically, in the US and most OECD countries, polluters have paid around 2 to 2.5% of GDP to clean up their worst pollution. However, United Nations Environmental Program (UNEP)[9] estimates that the annual environmental cost from global human activity was 11% of global gross domestic product (GDP) in 2008, and the number will rise to more than 17% by 2050. So we are not paying for anywhere near all the costs we incur.

Why is this relevant?

Because the day is coming closer that businesses will have to pay for the environmental damage they cause. UNEP and Trucost, the environmental data provider, together estimated[10] that over USD 2 trillion of environmental damage in 2008 was caused by the world's 3 000 top public companies. If these businesses actually had to pay for these damages, then around a third of them would no longer be profitable. Of course in reality prices to the end customer would rise to reflect the increased operating costs and cleaner technologies would become commercially preferable.

Externalized costs are a good at foretelling probable areas of new regulation that will ultimately drive all businesses toward sustainability, with measures such as the Carbon Reduction Commitment, Greenhouse Gas Emissions Allowance Trading Scheme and the Environmental Liability Directive all being relatively recent examples of the way governments are seeking to get responsible behaviour from their corporate citizens.

3.4 Reputation? What reputation?

While paying attention to the law, it is important to remember that there can be an even higher court that holds businesses to account, the court of the consumer. Even if a business is meeting the letter of the law, but is violating its supposed social contract in some way, it can attract consumer boycotts and loss of revenue.

Of course many businesses are hidden away in the supply chains of big brands. But this can still make the big brand vulnerable, as many ICT companies have found to their cost when it comes to working conditions in their supply chain. On the environmental front, the common accusation is that companies are only interested in "greenwash," not a genuine performance in the area of sustainability. As a result many large businesses are increasingly building sustainability issues into their procurement standards. Some ICT companies, are also making public their supplier lists in an effort to demonstrate transparency on these issues.

The key here is to understand why the business may be vulnerable to sustainability-related risks, prioritize and, if possible, monetize them, and then introduce mitigation strategies.

Meeting customer and other stakeholder expectations is about winning the licence to operate, while exceeding them is about building brand loyalty and enhancing customer "stickiness." The first step here is to understand what those expectations are and how addressing them delivers business value. The trouble with talking to stakeholders is that it always generates a long list of expectations. But companies need to be prepared to deal with dilemmas, as different stakeholder groups can pull the business in opposite directions!

3.5 Employees care about sustainability too

Increasingly, it is the company's own employees that are the reason why businesses want to do better when it comes to sustainability. This is because the employee knows the most about how a business is really

[9] www.unep.org/.

[10] http://archive.constantcontact.com/fs015/1103244704571/archive/1103736519020.html.

operating, and can often see through greenwash or corporate untruths. When a company's reputation takes a battering from external pressure groups, (Greenpeace, Shell and Brent Spar is the classic example of such external action on a company's brand), it is the employee workforce that often needs to be encouraged that their employer is doing the right thing.

A company's employees are often a fairly representative cross section of society and, given the low levels of public trust in business, many will be questioning the motivations of their bosses. Finding ways of motivating employees by being seen to be doing the 'right' thing, or even better involving them in it, builds employee motivation. And 'happy' employees mean more productive employees, and improved customer relations.

Increasingly, attracting and retaining talent is also influenced by the company's sustainability reputation, particularly when it comes to graduate recruitment.

3.6 New opportunities

Finally, but by no means least, new sustainable products are opening up major new markets and creating business opportunities. These opportunities span from clean technologies, such as renewable energy generation, to sustainable sourcing in the food and agriculture sectors, to innovative design that makes our businesses and homes more efficient. As already discussed, the ICT sector will play a key role in enabling other sectors to achieve superior sustainability performance.

But is there really a New World of opportunity out there?

Let's take carbon as an example. Already, businesses have started transitioning to a low-carbon economy, whether driven by climate change regulation, high oil prices, energy security, or plain competitive pressures from peers that have already made such investments.

Whatever initiatives are currently in place, as a planet we have only made baby steps. It is widely expected that for global temperatures to rise by less than two degrees centigrade, global greenhouse gases should fall by 90% from today's levels by 2050[11]. In 2000, it took 32 billion tons of carbon to produce USD 32 trillion of global GDP. Taking economic growth into account, McKinsey estimates[12] that by 2050, we will need to use 5-10 billion tonnes of carbon to produce around USD 145 trillion of global GDP.

To put it another way, carbon productivity is going to have to rise by 5-7% a year till 2050, when in the previous fifty years (when carbon was not seen to be an issue) the historic rate is 1%.

Making these huge changes to the way we work today will create generations of new global winners, and some massive global losers. Sustainability, enabled by ICT, will be the key strategic weapon in this world.

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[11] Weaver, A., Zickfeld, K., Montenegro, A., and Eby, M., Long-term climate implications of 2050 emission reduction targets, Geophysical Research Letters, 2007, http://wikyonos.seos.uvic.ca/people/alvaro/Emi_2050.pdf.

[12] Boccaletti, G., Loffler, M., Oppenheim, J.M., How IT can cut carbon emissions, McKinsey, 2008, https://www.mckinseyquarterly.com/How_IT_can_cut_carbon_emissions_2221.

4 Conclusions and next steps

Although the Toolkit on sustainability for the ICT sector is wide-ranging in its scope, and substantial in the assistance it offers ICT companies in dealing with their business and sustainability challenges, it is by no means complete in itself. There is room for it to mature and develop. Here are some ways in which this can happen.

4.1 Extending the scope

Although there is a document covering e-waste in detail, and quite a few other documents explore other environmental issues, much of the focus of the toolkit is on energy and greenhouse gas emissions. This is entirely appropriate, as the world starts to figure out how to deal with the interactions between climate change and human activity. It also reflects the fact that most other standards setting organizations have focused on carbon footprints and GHG emissions in the work they have done.

However, environmental management needs to be more than just carbon or energy. It is also about water, land use, waste and pollutants. Sustainability practices, as well as the tools, guidelines and methodologies, need to move into the wider sphere of environmental impacts if they are to be helpful to organizations beyond carbon.

4.2 Deepening the metrics

Thanks to the focus on carbon and GHG emissions, KPI metrics relating to these issues have good coverage in the ICT sector. However, more work needs to be done to extend the metrics to other environmental KPIs.

Possibly a more significant challenge is the fact that sustainability KPIs are unevenly distributed across the ICT sector. Data centers, for example, are very well covered when it comes to environmental metrics such as energy, water, as well as more business-focused metrics, such as processor utilization. It is the two types of metrics, taken together, that give data center managers significant insight on the performance and management of their resources.

Other areas of the ICT sector, such as broadcasting or desktop infrastructure, are much further back when it comes to having suitable metrics that tie together business performance and environmental performance. Desktop infrastructure metrics, for example, are usually tied to the energy performance of a single PC. The metrics here need to extend to cover the performance of the desktop infrastructure taken together, and related to how the infrastructure is used. Broadcasting, which requires the working together of many different ICT disciplines such as data centers, networks, PCs and broadcast systems, needs the development of a similar set of metrics that bring together metrics developed for other areas into a context that is relevant to how broadcasting organizations use such assets.

4.3 Lowering the questionnaire burden

As many companies around the world implement sustainable supply chain practices, they have started engaging with their suppliers, often via a questionnaire that seeks answers to specific issues that are important to that particular company. However, in reality, many of the questionnaires cover the same issues. So, in practice, an ICT company may receive many questionnaires from different customers, often asking for the same information, sometimes in slightly different ways. The consequence is questionnaire fatigue, resulting in poor data and lower supplier engagement.

What might be helpful is a common set of metrics that apply across the ICT sector, which companies provide the data for via public reporting. The Toolkit on sustainability for the ICT sector already has check-lists in each document that provide a helpful summary of the metrics and methods that ICT companies can

use to help their sustainability management. The next step could be the application of a standardized data set, covering check-lists, metrics and tools that all ICT companies use for reporting their sustainability performance.

4.4 Implementing the toolkit

While there are some exemplars within the ICT sector who are already utilizing best practices in the sphere of sustainability management, many companies have not got started, either because they have not understood the issues well enough, or because the entry bar is too high in terms of knowledge and the need for tools.

The Toolkit on sustainability for the ICT Sector offers an excellent starting point for the company that wants to start or deepen its management of sustainability issues. It identifies the issues, helps in the prioritization of those issues, and then in the selection of standards, tools and methods that enable these issues to be brought to life in the context of the company's workings.

However, some companies will need more than this. They will need a training and implementation plan so that they can have a practical approach to bringing this area into standard management practice in their organizations. Such a training and implementation plan does not currently exist.

Further, the issues raised in the toolkit have significance for policy-makers. In many countries, policy-makers are already exploring putting together rules, regulations, directives and guidelines, or have already started doing so. What the toolkit offers is a guide on all the issues that companies may face on sustainability issues. However, it might be really helpful for policy-makers to have access to a tool that captures the sustainability impacts discussed in the toolkit in a way that enables them to think about reasonable formulations of policies and regulations that they can apply to their national economies.

Finally, given the enabling role that the ICT sector plays in other industries, and the way its own negative impacts are expected to grow, it would be useful to have access to industry-wide information about the performance of the ICT sector in the management of sustainability impacts. The Toolkit offers a starting point for what these metrics could be. If ICT companies adopt these ideas, it might be useful to bring researchers and universities into play, so that the data from the companies can be consolidated and analysed to provide further insight on the performance of this sector. There is a further potential benefit in that universities that engage on this might well provide really good training resources for companies that want to learn how to implement sustainability management in their own set-ups.

The combination of an implementation guide, engagement with policy-makers, and working with universities and researchers might have a particularly helpful impact when it comes to getting these ideas working in developing countries, where getting access to the skills and resources needed might be harder, and could result in the so-called standardization gap.

4.5 Suggestions for further work for ITU-T Study Group 5

Throughout the toolkit, a number of areas have been identified where there is need for initial or further studies in order to develop standards of practice. ITU-T Study Group 5 (SG5) is working on a series of activities relating to ICTs and climate change[13]. A number of issues listed in the documents of the toolkit deserve further work, and it is suggested that ITU-T SG 5 initiates studies in these areas:

- Much more work has been done on creating a set of metrics and standards for data centers than for desktop infrastructure, broadcasting services and networks. The latter areas need the same level of definition, industry-wide acceptance and adoption of metrics and standards as has been achieved so far with data centers.
- A new ITU-T Recommendation on metrics for data centersis needed which integrates energy consumption metrics with metrics relating to business strategy and business use. It is possible to turn off sections of the data center in line with business needs and yet improve the PUE score. This feels counter-intuitive with good business strategy. We need to see metrics in this regard where better metric scores align with better business practice. Could the use of metrics based on watts per gigabyte of data, or watts per user provide metrics that align better with business practice?
- Standard specifications are needed on the interface of a DC power feeding system and its architecture.
- There are considerable energy efficiency gains in the area of cooling, including fresh air cooling, direct air economizers and indirect air economizers, but further studies are needed to show how these benefits can be introduced and managed in data centers. As ETSI and ASHRAE are developing work items in this area, one possible way might be for ITU-T SG 5 to work jointly with these bodies.
- Organizations that are seeking to manage desktop infrastructure can benefit from access to energy consumption data regarding ICT equipment, particularly if this data can be integrated into their energy management applications. However, data from organizations such as Energy Star and EPEAT are currently not available via API access. ITU-T SG 5 can define standards by which such data can be shared in open formats.
- Most metrics relating to desktop infrastructure apply to individual machines as opposed to a divisional or organizational footprint, where much work needs to be done, both in terms of metrics and on best practice frameworks.
- Thanks to a number of studies, it is possible to understand what good practice looks like in terms of energy utilization in data centers. However, there is no such depth of information available when it comes to benchmarking of desktop infrastructure.
- Metrics and frameworks for best practice are needed on energy stations needed to power mobile network nodes.
- Although next generation networks (NGN) are expected to deliver 30-40% energy savings compared to traditional networks, a study is needed to capture the sources of energy savings in NGNs so that their benefits are not lost.
- Although there are metrics relating to energy consumption of DSLAMs, there is a need for energy metrics that apply across an entire network.
- Network equipment needs power saving modes which can be fully operable at low or no traffic periods. Standards are needed for such modes to be implemented fully across networks.

[13] Study Group 5 is the ITU-T Study Group responsible for studies on methodologies for evaluating ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way. Under its environmental mandate, SG 5 is also responsible for studying design methodologies to reduce environmental effects, for example, recycling of ICT facilities and equipment. www.itu.int/net/ITU-T/info/sg05.aspx.

- A study is needed on energy savings possible through the use of alternative power schemes in cellular base stations, including alternative energy sources as well as optimized methods where diesel generators are run for a few hours at full power to charge batteries, and then the generator is switched off at other times while the station runs on battery power.
- A study is needed on the energy efficiency metrics applicable in the broadcasting industry, covering production, lighting, storage, post-production, transmission and networking.
- A study is needed on the relative sustainability impacts of terrestrial, cable, satellite and online distribution channels.
- For further work, guidance could be provided on a solution to the following problem: a person or organization needs to procure a basket of ICT services – what is the best combination of transmission system(s) to choose from in order to meet the service requirements and have the least environmental impact? The available technologies include: broadcast services (TV and radio), mobile cellular (2, 3, and 4G), fibre (passive optical network and point-to-point), twisted pair, Ethernet (LAN), WLAN and cable (TV) networks.
- Overall, the broadcasting industry has not benefited from the sort of wide-ranging work that has been done in other sectors, such as data centers where there is considerable sophistication in measuring and managing environmental performance.
- A study is needed on the energy efficiency metrics applicable in the broadcasting industry, covering production, lighting, storage, post-production, transmission and networking.
- The document on product sustainability currently addresses only the environmentally conscious aspects of an ICT product's total life cycle. As they only address the environmental considerations for product design, they stop short of full sustainable design, which would encompass social and ethical aspects. The recommendation is that SG 5 initiates studies and evaluations for the next step of integrating social and ethical aspects into the overall toolkit.
- Life cycle assessment is a key method to helping designers evaluate an ICT product and determine opportunities to improve on its measurements and performance. As such, the suggestion is for the further development of tools and their associated databases that support designers in their development of ICT products for a low carbon society, i.e. tools that promote more efficient and simplified approaches to deriving eco-impact results. This applies to both the measurement and assessment of the direct eco-impacts associated with the life cycle stages of the product, and also to the enabling effects associated with the ICT product applications and its benefits to helping society attain a sustainable economy and life style.
- As energy efficiency is a critical factor in having the most potential to reduce the eco-impacts of ICT products over their entire life cycle, SG 5 should focus future work on metrics for measuring energy efficiency of ICT products and in their deployment within systems, networks and grids. These latter entities can be quite complex in scope and operation, and therefore need the development and standardization of suitable metrics and tools for their effective evaluation and improvement.
- Materials and their selection and use within ICT products to produce eco-sustainable products is another topic that needs further work. It is suggested that SG5 should address the development of collective lists of sustainable materials that designers can apply in their product development work. These lists can categorize materials according to their characteristics and sustainable attributes – environmental, social and economic. From this, designers can choose appropriate materials and also provide labelling indicating such choices – or in reverse, list any product materials that are not on the sustainable lists.
- Recycling materials needs to be further emphasized, with information being provided to recycling entities that would help create an understanding of the major types and classes of materials that are within a particular product family. This can be emphasized with certain key materials such as precious metals, rare metals/rare earth metals. Further research into the recycling and reuse of plastics within

the ICT product can also be addressed by SG5. This would include the use of bio-plastics and their full life cycle evaluation as a substitute for more traditional fossil fuel based plastics.

- ICT product design issues, including clean supply chain; reduction of the demand on limited natural resources, which is measurable and tractable; designing products that through their different life cycle stages reduce environmental impact and waste generation; designing, producing, labelling in compliance to the requirements of legislation in place, commercialization of products that have a reasonable extensive life and that once they achieved the end-of-life, can easily be repaired or dismantled for reuse or its value recovered via recycling or its life finalized in the best environmental possible manner without impacting economic growth.
- Technical guidance applicable to refurbishment and repair facilities as well as marketing of used ICT equipment, including risk prevention and minimization; processing and management of equipment and components destined for reuse; management of materials, components and residuals destined for recycling or disposal; and, record keeping and performance measurement (partly covered here).
- Environmental and socio-economic aspects**:** uncontrolled burning, disassembly, and disposal causes a variety of environmental problems affecting directly or indirectly human health such as erosion of land, high water demands and contamination of ground sources, air pollution with carcinogens and neurotoxins. Fumes include dioxins and furans. Inappropriate method of processing waste could lead to, deforestation and the inevitable relocation of communities, animal life as well as the disappearance of ecological habitats. In addition, this could lead to health problems including occupational health and safety issues, affecting those who are either directly and indirectly involved, due to the methods of processing the waste; etc. (partly covered here). There must be a direct guidance to the industry in order to help governments and communities to end bad practices such us uncontrolled burning and to secure that material is being handled properly. This industry movement needs to take into account the micro-economics that have been developed around those practices harmful as they are to society and the environment, because they represent are the only income for thousands of families who cannot be excluded from employability access in the world.
- Principles for donors of ICT equipment**:** ensure that products are functional and that appropriate products are provided; availability of technical support in the country of destination; and, ensure full transparency, contract and notification and consent prior to delivery.
- Development of national ICT policies**: e**nsure that the life-cycle approach is used for developing national ICT policies. This means that such issues, as, *inter alia*, green design, collection, recycling, disposal should be considered in the policy.
- Develop a map or guidance document that lists all different end-of-life standards currently available around the world, highlighting the aim, resources needed, pros/cons, boundaries, expectations, possible overlapping or relation with others, as well as the differences among them. This document, which would need to be updated regularly, will be of help to the user to identify, differentiate, and make an independent decision over which standard to use according to the needs and objectives of the stakeholder on its specific role within the recycling chain.
- Development of a global CO_2 – equivalent market**: d**eveloping a market for CO_2 trading will help to directly control and incentivize reduction on pollution emissions through the use of best practices available and technology, as well as making use of economic incentives and fees over the direct effect of the environmental impacts generated by inappropriate ICT disposal, locally or overseas.

Recovery of rare metals and green ICT supply chain: in the effort to achieve a green supply chain within the ICT sector, it is suggested that ITU-T SG5 actively includes and facilitates access to the recycling and precious metals industry in the discussions and possible developments that aim to return such metals to the industry with the physical and technical characteristics needed to satisfy new equipment production requirements. It is this industry that has the practical knowledge on the technical aspects and feasibility opportunities and limitations of the recovery process.

Annex A note on emissions protocols

An organization is responsible for greenhouse gas (GHG) emissions in a number of ways, either directly by burning fuel or processing chemicals, or indirectly by purchasing energy from other sources. ICT companies need to be aware of where and how their emissions are counted. This should then drive their emission reduction strategies, against which they should be accountable through their sustainability reporting.

The Greenhouse Gas Protocol is a collaboration between the World Resources Institute (WRI) and the World Business Council on Sustainable Development (WBCSD).[14] It differentiates between three different categories of emissions, known as Scope 1, Scope 2 and Scope 3.

Recommendation ITU-T L.1420[15] explains how ICT companies need to consider the various categories:

Scope 1 GHG emissions

Scope 1 covers the GHG emissions generated by facilities within the boundaries of an organization. For most ICT companies, this usually refers to the combustion of fuels for heating offices, power supply of ICT equipment either for backup or, in more recent times, for cogeneration, or the power needed to cool ICT equipment. It also covers emissions resulting from intentional or unintentional releases of coolant from equipment, such as air conditioning plants in data centers. Scope 1 emissions will also cover emissions from vehicles owned by ICT companies.

Scope 2 GHG emissions

Scope 2 covers the indirect emissions from the generation of purchased electricity, heat or steam consumed by the organization. Most ICT organizations buy the majority of their electricity from utilities in order to power their computers, data centers, communications equipment, heating, lighting, cooling and use of other office equipment. As a result, most emissions from the internal operations of ICT companies are reported in this category.

Scope 3 GHG emissions

Scope 3[16] covers a company's entire value chain emissions impact, and enables a company to track the full impact of its upstream and downstream impacts. It is at the company's discretion what it reports under scope 3 and most companies will keep it to easily measured items such as corporate business travel. Full life cycle scope 3 reporting is still very rare.

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[14] Since the publication of the first edition of The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Corporate Standard) in 2001, more than 1 000 businesses and organizations worldwide have developed their GHG inventories using the GHG Protocol. Some of the world's largest companies are using the GHG Protocol's Corporate Standard. www.ghgprotocol.org/.

[15] Recommendation ITU-T L.1420 Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communications technologies in organizations, International Telecommunication Union, February 2012.

[16] Companies wanting to assess Scope 3 GHG emissions need to take into account the categories listed in Annex C of Recommendation ITU-T L.1420 Methodology for energy consumption and greenhouse gas emissions impact assessment of Information and Communication Technologies in organizations.

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