Department
for Environment
Food & Rural Affairs

Helping businesses create a greener, more sustainable future through ICT

An industry guide by Defra in collaboration with our ICT (information and communication technology) industry suppliers & partners

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Foreword

As our modern world grows increasingly dependent on information and communication technologies (ICT), so our responsibility to deliver and use these in sustainable ways has never been more important.

Defra's vision is clear and compelling: we are here to make our air purer, water cleaner, land greener and food more sustainable. Central to delivering this vision is a close partnership between government, industry and other actors to achieve the United Nation's Sustainable Development Goals (SDGs) and implement the UK Government's 25 Year Environment Plan. These documents are the blueprints to create a better, more sustainable future for all. They interconnect to address major global challenges such as poverty, inequality, climate change and environmental degradation.

Addressing the sustainability of ICT is critical to achieving the objectives set out in the above documents. Technologies have major environmental impacts. In our ever more digitalised world, they enable organisations to do things differently, and their use will only increase.

That is why, in 2018, Defra's Digital, Data and Technology Services directorate launched the Joint Sustainable Information and Communication Technologies (ICT) Group. The group consists of multinational organisations from our ICT supply chain who have joined forces with us to share, promote and implement sustainable ICT best practice.

The group is facilitating an intensive global engagement to bring together governments, the private sector, civil society, the UN system and others to mobilise all available resources to support implementation of key sustainability goals. This guide is the culmination of their work, bringing together the latest best practice guidance to support all businesses, whatever the industry or size, to make more sustainable ICT choices.

Chris Howes

Chief Digital Information Officer

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About this guide

This guide has been developed by Defra and its partners for use by ICT managers and architects, ICT users and ICT manufacturers, disposers and recyclers. In the context of the ICT sector, it applies the UN's SDGs, the UN Guiding Principles on Business and Human Rights, United Nations Environment guidance on chemicals and waste, and the UK Government's 25 Year Environment Plan.

While this guide is not intended to be legally binding, it is the result of extensive research and multi-stakeholder consultation, and sets out the urgent case for action on ICT sustainability. We are very grateful to all the civil servants, business, industry, civil society representatives, academics and other experts whose input helped to shape the final document. This guide provides:-

- An overview of the key sustainability challenges and opportunities in relation to a circular economy, sustainable procurement, ecological footprints and ISO standards;
- Guidance on best practice, including the key steps expected of organisations to integrate sustainable ICT into their own supply chains, systems and ways of working;
- Hyperlinks to additional resources to support organisations in meeting their ICT sustainability goals.

This guide is an evolving document and will be complemented by case studies and live examples via the Defra e-Sustainability Alliance (Defra DeSA) website. We welcome ongoing input: if you have feedback or a contribution you would like to make, please e-mail Mattie Yeta SustainableICT@defra.gov.uk

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We would like to thank the following organisations for supporting the development of this guide:

Circular economy

The circular economy is a model of economic activity that aims to replace the traditional linear economic model. Under the linear model, raw materials are used to make a product and after its use, any waste (e.g. packaging) is thrown away. In a circular economy, materials and products are made and reused more efficiently in order to prevent waste.

Benefits of a circular economy

Moving to a circular economy will reduce costs to organisations and stabilise supply chains over the long term:-

- Research by the McKinsey Center for Business and Environment and the Ellen MacArthur Foundation demonstrated that a circular economy could boost Europe's resource productivity by 3% by 2030, generating annual cost savings of €600 billion and €1.8 trillion more in other economic benefits[1];
- Friends of the Earth estimates that meeting national and global recycling targets could create new jobs, for example 20,000 potential new jobs in the UK economy if the target was broadened to include commercial and industrial waste[2];
- With scarce natural resources, typically there is more gold within 1 tonne of printed circuit boards (PCBs) than within 1 tonne of gold ore; and there are other precious metals and valuable materials within ICT equipment, recovery of which is also economically viable.

Despite these benefits, the Circularity gap report[3] (published in January 2019) indicates that the world's economy is only 9% circular and becoming less so, making it environmentally unsustainable. To reverse this trend and create a cleaner and greener future, organisations and society need to maximise use of resources already extracted.

Implementing a circular economy

Moving to a circular economy requires a robust, joined-up approach, with integrated management systems and clear policies and objectives that are supported by plans and processes to achieve them. We go on to explain these in this section.

Given their increasing use and ability to enable organisations to work in new ways, digital technologies such as sensors for tracking and for feedback on operational parameters are key to implementing a circular economy.

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[1] *Growth within: a circular economy vision for a competitive Europe*, McKinsey & Co, 2015

[2] *More jobs, less waste: Potential for job creation through higher rates of recycling in the UK and EU*, Friends of the Earth, 2010

[3] *The Circularity Gap Report*, Circle Economy, 2019

Growing recognition of the importance of sustainability is reflected in more stringent legislation, for example in relation to ethical sourcing and disposal of end-of-life electrical equipment. Regulations such as the Waste Electrical & Electronic Equipment (WEEE) regulations are now routinely adhered to by organisations and the public.

Product manufacturing and use

Manufacturers of ICT have a key role to play in accelerating the move to a circular economy:-

- ✓ Consider reuse of products upfront in the design process (cradle to cradle) and throughout the entire product lifecycle (cradle to grave);
- ✓ Offer leasing services (selling services instead of selling hardware) and flexible capacity (so that customers use only what they need). Note: if your organisation remains the owner of a leased product, deposits on that product or ‘first right to refusal’ will require you to track where products are at the end of the lease, reclaim products and increase the residual value of after-use products;
- ✓ Collect ICT products from customers after the lease period, through trade-in and return-for-cash programmes (second-hand market);
- ✓ Encourage customers and your organisation to re-use and recycle products and material so that very little goes to waste and as much material as possible is returned into the supply chain for manufacturing.

Overview of sustainable practices to support circular economy

Production

- ✓ Use recycled materials from products to packaging
- ✓ Design products and packaging for reuse, recyclability and disassembly
- ✓ Use material with sustainability benefits
- ✓ Responsible production (avoid the use of restricted and harmful chemicals, modern slavery, conflict minerals)

Procurement

- ✓ Look for eco labels (e.g. EPEAT, Energy Star, Energy Efficiency)
- ✓ Choose products that minimise energy consumption/CO2 emissions
- ✓ Opt for durability, easy maintenance and reparability

End of life

- ✓ Choose reputable providers for recycling and final disposal
- ✓ Demanufacturing, refurbishing and remanufacture and reuse

Waste management

A circular economy requires businesses to adopt a zero waste approach, working to completely eliminate waste from the supply chain.

It is important to clearly define waste in order to devise and implement effective waste management strategies and controls:-

- Waste is defined as material considered by the producer or holder as requiring disposal;
- Disposal is a general term used to encompass: end of use, end of life, failed, refurbishment, donation, recycling, and preparation for reuse.

When applying the waste hierarchy, consider the following when implementing zero waste principles and approaches:-

- ✓ Aim to send zero to landfill and introduce solutions to achieve this;
- ✓ Comply with duty of care and raise waste transfer notes, with hazardous waste transfer notes if the item is considered hazardous;
- ✓ To avoid products being defined as waste, aim for reuse for the same purpose as originally intended, including leased product and product for donation;
- ✓ Only consider incineration where waste would otherwise endanger human health. It is argued that without incineration, most countries could improve current recycling rates;
- ✓ Adopt the product end of life hierarchy (shown above) as a way of prioritising outcomes.

Urban mining

Obtaining large quantities of precious and rare earth metals can be highly detrimental to the environment and communities. For example, around 15 million people work in the artisanal and small-scale gold mining (ASGM) sector globally, including over 600,000 children and 4.5 million women. While ASGM represents developmental opportunities for rural populations, studies indicate[4] that there are risks associated with this work. For example, mercury exposure (a largely neglected global health problem) puts miners and their communities at risk of health impacts such as permanent brain damage, seizures, vision or hearing loss and delayed childhood development. Moreover, other negative impacts on human rights, in particular, children's rights which could range from health and safety, child labour to loss of education when children need to contribute to the family income, sexual exploitation and violence, loss of livelihood and conflict related to land use and recruitment into militia [5].

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[4] *Global Burden of Disease of Mercury Used in Artisanal Small-Scale Gold Mining*, Annals of Global Health, Volume 83, Issue 2

[5] *Children's Rights and the Mining Sector, UNICEF Extractive Pilot* highlights a wider range of child rights impacts associated with artisanal and small-scale mining (see page 16), available at

In contrast, urban mining is the practice of recovering metals such as gold, copper and others from electronic waste. Making innovative use of materials already in the supply chain reduces the need to extract new materials and cuts the amount of waste. This is not only more environmentally appropriate than extracting virgin materials, it can also be more cost-effective.

Exploring the urban mine requires careful planning by ICT manufacturing organisations; for example:-

- ✓ Develop new recycling technologies/methods to recover precious and rare earth metals and materials from complex waste streams, cutting the amount of new waste going to landfills;
- ✓ Design products and components so that they can be taken apart easily, creating cleaner waste streams;
- ✓ Design materials, components and products so that they can be reused and recycled more easily;
- ✓ Develop products which meet the chemical restrictions of the International Stockholm convention as well as local laws and restrictions.

Material recovery methods

When metal is extracted through traditional mining, it creates significant negative impacts on the environment, drastically affecting air and water quality. Traditional mining also requires the use of harmful chemicals such as mercury, among others, for purification and refinement processes.

The following processes are alternatives to traditional mining and should be considered as established methods of extracting primary and secondary raw materials. They are usually processes that are used for reclaiming primary and secondary raw materials from ore or e-waste.

Bioleaching process

The challenge of how to obtain rare earth metals sustainably has yielded creative alternatives: bioleaching is one of them. Bioleaching, now in development, is the extraction of metals from their ores through the use of living micro-organisms. It makes use of certain bacteria that can break down low-grade ores to produce an acidic solution containing copper ions. This will create a sustainable and cost-effective way of recovering precious and rare earth metals directly from waste electrical and electronic equipment (WEEE), predominantly the material-rich, complex composition of printed circuit boards (PCBs).

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https://www.unicef.org/csr/files/UNICEF_REPORT_ON_CHILD_RIGHTS_AND_THE_MINING_SECTOR_APRIL_27.pdf.

Pyrometalurgical process

Pyrometalurgical is the purification and extraction of metals through processes involving high temperatures such as smelting, roasting and refining. The energy required to sustain the high temperature may come from the nature of the chemical reaction taking place (oxidation) or in many cases energy must be added to the process via combustion of fuel or by direct application of electrical processing.

Hydrometalurgical process

Hydrometallurgy processes use aqueous solutions (water/liquid) to extract metals from ores. The most common is leaching, which involves dissolution of valuable metals into the aqueous solution. After the solution is separated from the ore solids, the solution is often subjected to various purification and concentration processes before the valuable metal is recovered, either in its metallic state or as a chemical compound.

Conclusion

Supporting a circular economy requires new thinking and concerted action to reverse negative unsustainable trends. This includes but is not limited to: more sustainable product development, use and sourcing of materials, ICT use, energy efficiency, end-of-life management and packaging.

For many forward thinking ICT organisations most of these ideas are becoming mainstream thanks to the influence of government and pressure groups, as well as public opinion. However, more action by organisations is urgently needed, in collaboration with others across industry, to accelerate the move to a circular economy. Pressure from organisations through their procurement demands and choices will contribute towards that.

In particular, innovation to source materials that already exist within the supply chain is key to sustainable manufacturing. Technology companies need to increase reliance on secondary metal production, including all metals that no longer serve their initial purpose but have already entered the economy, as well as plastics.

More effective, concerted waste management with a zero landfill approach is a key priority. Much more can be done to reduce consumption of completely new products, including product leasing and pay-as-you-use services.

A circular economy must lie at the heart of a greener, more sustainable future: working together industry, government, pressure groups and individual citizens must promote and enact it for the benefit of the environment and future generations.

Sustainable ICT procurement

Procurement of ICT and procurement by manufacturers of ICT is a strategic activity that has the power to shape supply chains and the environment. Sustainable procurement incorporates sustainability considerations throughout the procurement process in order to achieve value for money. It is crucial to take sustainable procurement considerations into account from the outset.

Research[6] shows that three quarters of millennial-age consumers and citizens rate sustainability as a priority. That means that showing demonstrable sustainability in your business practice and supply chain can have a significant positive impact on your reputation and along with it your bottom line.

Opt for suppliers that demonstrate sustainable practices such as:

Environmental

- ✓ Phasing out single-use plastics
- ✓ Using energy efficient products (e.g. EPEAT, Energy Star, Energy Efficiency)
- ✓ Monitoring and reducing greenhouse gas emissions and using renewable/green energy
- ✓ Increasing resource efficiency, reducing and minimising waste
- ✓ Reducing energy and fuel consumption
- ✓ Sourcing packaging from 100% sustainable material (made from renewable resources (plants) and recycled resources).
- ✓ Ensuring implementation of environmental management systems (e.g. ISO 14001)

Social

- ✓ Monitoring labour standards through the supply chain
- ✓ Including a strong anti-bribery and anti-corruption policy
- ✓ Collaborating with communities for example, by encourage staff and volunteers to share ICT skills or take laptops and other mobile equipment to community centres to provide computer and internet access to support community activities
- ✓ Conducting human rights due diligence
- ✓ Complying with:

[6] *Deloitte, Millennial Survey*, 2016

- international standards such as the OECD Due-Diligence Framework for Responsible Business Conduct and the UN Guiding Principles on Business and Human Rights
- provisions of the Equality Act 2010
- the Modern Slavery Act 2015 (Inc Statement >£36m)
- Reasonable Country of Origin Inquiry

Economic

- ✓ Paying a living wage to employees
- ✓ Enhancing the Country Growth Agenda
- ✓ Creating sustainable jobs
- ✓ Supporting young people into apprenticeships

Cost benefit research and analysis

Within almost every organisation, there is a justification and review process for procurement. When evaluating and selecting suppliers, ICT buyers need to:-

- ✓ Consider the 'total cost of ownership';
- ✓ Incorporate energy analysis and/or product lifecycle analysis.

Analysing whole-life impacts and whole-life costs of a product or service will help to identify the most sustainable procurement option. Options may include: hiring or leasing equipment, procuring a service rather than a product, end-of-life options and closed loop systems.[7]

Here are some example questions to help with cost benefit analysis:-

- ✓ What are the relevant sustainable products and services available on the market?
- ✓ What are the expected sustainability benefits?
- ✓ What are the anticipated cost and value for money propositions?
- ✓ Can the market deliver new or customised solutions or innovate?

[7] Closed loop is the conversion of the used product back to raw material, allows repeated making of the same product over and over again.

Assessing sustainability risks and opportunities

Assessing sustainability risks and opportunities is a key activity and requires a wide-reaching assessment of all suppliers in the supply chain. This assessment should cover the following: supply chain, vendor capabilities to deliver services and products in a more sustainable way, operating environment, market conditions and human rights. It can be done using industry tools developed by Defra (such as the prioritisation tool or environmental impact), country-specific frameworks and global frameworks such as UNICEF's toolkits and Children's Rights and Business Atlas tool which are designed to help businesses integrate children's rights into due diligence procedures and assess their impacts on children's rights in particular contexts and countries. A desk research by individual buyers is necessary.

To assess sustainability risks and opportunities, an organisation's decision framework should focus on five key areas:-

- ✓ Product design;
- ✓ Material selection including packaging;
- ✓ Production process;
- ✓ Finished product delivery to the customer;
- ✓ Management of products at the end of their lifecycle.

Risks relating to poor practices rarely arise from less committed parts of the supply chain. These risks are passed onto companies that may inadvertently buy from unethical or uneducated suppliers; it is therefore necessary to carry out a full assessment.

Organisations should also consider the length of the supply chain; for example, ICT equipment manufacturers are, to some degree, 'ICT assemblers', and meaning that they may not produce products from unprocessed or semi processed material to final product. One common requirement of buyers is for manufacturers to publicly list their major suppliers. The extent of supply chain disclosure generally accepted by leading companies and customers would be to share data on final assembly suppliers and major component suppliers.

Implementing sustainable procurement standards

A common misperception is that the supply chain is not improving; a more accurate reflection is that through a global commitment to corporate social responsibility, standards have been advancing and suppliers may find it difficult to keep up with evolving requirements.

To support public and private sector buyers, there are three actions that organisations can take:-

- ✓ Agree and implement a common code of conduct aligned with international standards (see section below – international standards and codes of conduct);
- ✓ Audit/vet your supply chain and create a corrective action plan (CAP) following each audit to identify and schedule the resolution of any non-conformities.
- ✓ Conduct human rights due diligence

This will create a scalable and reputable model for buyers while reducing audit fatigue and cost for suppliers.

International standards and codes of conduct

It is the relevant certifying authority's responsibility to verify a supplier's sustainability standards. However, it is the procuring organisation's responsibility to perform due diligence and obtain relevant confirmations from the certifying body.

Organisations around the world use the OECD Due-Diligence Framework for Responsible Business Conduct as a way to holistically manage their supply chain responsibilities. You can organise and distil elements of this framework into practical steps for buyers to use in the evaluation and measurement of sustainability.

Other examples of standards that demonstrate good sustainability practices include:-

- ✓ Technical capability (EMAS, ISO 14001:2015, and other certifications);
- ✓ Past experience (e.g. records of orders or references);
- ✓ Environmental technical competence (e.g. minimise accumulation of waste);
- ✓ Social responsibility (e.g. code of conduct incorporating the UN Guiding Principles on Business and Human Rights and the OECD Due-Diligence Framework for Responsible Business Conduct);
- ✓ Using eco/social labels (EPEAT, Energy Star, WaterSense, TCO, Fair Trade);

Once the goals and standards of the ICT procurement process are set, many organisations develop a 'supplier charter' or 'code of conduct' by which suppliers are asked to abide. This should align with international standards, for example, take into account the impacts on vulnerable groups such as children[8]. Supplier charters or codes of conduct should be contractually binding, regularly monitored and enforceable for the duration of the contract or period of supply.

The Responsible Business Alliance, for example, has developed a comprehensive code of conduct that references international norms and standards including the Universal Declaration of Human Rights, ILO International Labor Standards, OECD Guidelines for Multinational Enterprises, ISO and SA standards, and many more.

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[8] UNICEF, Introduction to Children's Rights in the ICT Sector, Module 1, available at https://www.unicef.org/csr/files/Training_Module_1_Child_Rights_and_the_ICT_Sector.pdf

Vetting your supply chain

To ensure that suppliers are behaving in a manner consistent with your charter, consider implementing a supply chain vetting programme. There are two options for this:-

- ✓ Develop your own mechanism (more advice on this below);
- ✓ Engage an expert third-party vetting organisation (e.g. Electronics Watch, the Responsible Business Alliance).

For routine procurements, it may be efficient to establish a list of suppliers that have already been vetted for sustainability accreditation and experience through the process mentioned above.

Using your own mechanism:

Advantages	Potential disadvantages
Assessment can be tailored to meet your specific needs	Inconsistency of assessments and scoring
Close engagement with the supplier, meaning that the importance can be specified	Falling behind current best practices and thinking in sustainability and business integrity
	Cost of and use of resource in building mechanism and performing assessments
	Increased burden on supply chain
	Lack of expertise may result in misinterpretation of data
	Duplicated effort (other buyers using the same suppliers are likely doing a similar assessment and supplier engagement, which could be more efficient if combined)
	Labour intensive: tracking the supply base with limited tools could require additional time and resources

Using a vetting organisation:

Advantages	Potential disadvantages
Consistency of assessments, across industries and geographies	Loss of direct supplier engagement
Expert knowledge in performing assessments	Assessments may not align fully with the charter, leading to the needs for supplementary questions (effectively a mini version of your own mechanism), requiring added time/effort
Harmonised code of conduct – alignment on all key social and environmental elements to which a supplier is held	Elements not included in the industry code of conduct must be added as award criteria rather than standard criteria. Most industry codes are updated frequently
Reduced supplier burden and reduced audit fatigue	Lower likelihood of follow-up of assessments findings / potential for suppliers not to take this as seriously as direct engagement
Customised supplier engagement programmes that support a struggling factory or other supplier to improve performance	Additional cost to a struggling supplier
More statistical rigour, including country-level reporting and industry-level reporting	
Comparatively low cost	

Conclusion

Sustainable and ethical buying of ICT equipment is critical for a greener future and a fairer world. As countries explore more sustainable procurement practices, international standards are developing. Due diligence on sustainability along the supply chain is moving from a ‘nice to have’ to a global requirement.

With governments and industry working in collaboration internationally, all countries and organisations can, together, have positive impacts on communities and the environment that no single country or organisation could achieve alone.

Sustainable procurement requires robust, evolving systems and processes with plans in place for continuous improvement. Your efforts to improve buying habits combined with those of others will go a long way to reducing negative impacts on people and the planet. There are also major cost benefits from sourcing more sustainably and considering total cost of ownership. Increasingly, key business and consumer decisions are being informed by sustainable practice and reputation. Action in this area will reduce your own risk of reputational damage from within your supply chain and enhance your corporate and social responsibility credentials.

With citizens' demand for sustainability increasing, there is a huge opportunity to leverage significant business advantage through sustainable procurement and positive engagement with others in your supply chain.

Ecological footprint

'Ecological footprint' is a useful term for expressing the impacts of an organisation or individual on the environment through the consumption and disposal of waste.

With ICT estates set to expand with ongoing digitalisation and the rapid growth of the Internet of Things (IoT), it will be vital to understand, monitor and reduce the impacts of ICT. This will enable organisations to contain energy spending, reduce the ecological footprint of often-complex global networks of devices, servers and users.

Scoring and measuring your ecological footprint

The direct environmental impacts of an ICT estate derive from the following components:-

- ✓ Laptops, PCs and tables;
- ✓ Networks, such as LAN, WLAN;
- ✓ Phones and telecoms infrastructure, such switchboards;
- ✓ Printers and paper used;
- ✓ Data centres;
- ✓ Other devices, such as TVs, projectors, augmented reality or virtual reality headsets;
- ✓ E-waste;
- ✓ ICT-related travel, from employees in the ICT function, or engineers providing support (optional depending on the size of the impact and how organisations report on travel and other aspects of their carbon footprint).

Sources and causes of environmental impacts from ICT

Use the following steps to calculate your environmental footprint; while these need not be in the order shown below, many feed into each other:-

- ✓ Understand and gather available data and identify gaps;
- ✓ Define key performance indicators (KPIs);
- ✓ Define KPI calculations;
- ✓ Gather requirements for reporting mechanism;
- ✓ Build reporting mechanism and calculate footprint;
- ✓ Engage and train stakeholders on outputs;
- ✓ Analyse data and drive action.

Reducing energy consumption

Many large organisations already report their carbon footprints according to international standards and requirements. Carbon emissions from energy consumption is the largest environmental impact of using ICT devices.

Ideally, your energy footprint should report consumption of primary energy sources and cover the complete supply chain of goods and services. However, in practical terms, it is generally not possible to calculate the energy consumption within the supply chain for purchased goods and services; therefore, the focus should be on energy purchased and consumed by your own business directly from an energy provider. This is effectively equivalent to energy that generates Scopes 1 and 2 greenhouse gas emissions as defined under the Greenhouse Gas Protocol (The GHG Protocol Corporate Accounting and Reporting Standard).

Below is a list of common sources of energy data and the environmental impact data they provide. Some of this information can be found from manufacturer's declarations and product sheets for example.

Source	Environmental impact measured	Data required
Laptops, PCs & tablets	Carbon emissions from energy consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred) • Number and location (country) of each device in estate • If available, energy consumption figures from smart sockets or specific area/network meters
Networks	Carbon emissions from energy consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred) • Number and location (country) of each device in estate • Operating times
Phones & telecoms	Carbon emissions from energy consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred) • Number and location (country) of each device in estate
Printers	Carbon emissions from energy consumption Carbon emissions from paper consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred) • Number and location (country) of each device in estate • Paper consumption • Operating times
Data centres	Carbon emissions from energy consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred where applicable) • Number of each device in data centre • Mapping of applications to individual servers or % of data centre energy consumption used by each application • Number of users per platform or application

Other devices	Carbon emissions from energy consumption	• Model • Total energy consumption (TEC rating by Energy Star is preferred) • Number and location (country) of each device in estate • Smart socket energy consumption data if available
E-waste	None explicitly measured using this methodology, however industry averages or manufacturers' data could be used to provide a figure	• Lifetime of assets • Number of devices reused, recycled or disposed of responsibly • % of devices sent to landfill as opposed to refurbished, recycled or repurposed
ICT-related travel	Carbon emissions travel and hotel stays	• Mode of travel • Distance of journey • Hotel nights • Number of stays and journeys

Examples of energy consumption

It is critical that businesses not only consider the built-in energy efficiency of their hardware, typically measured as performance per watt, but also leverage technologies that provide the intelligence needed to solve these provisioning challenges. Products with power and thermals sensors on critical components can be monitored in real-time remotely, and should be paired with tools that allow a user to see historical and real-time utilisation levels and power consumption in order to optimise their infrastructure as needed. Improved utilisation also results in improved Power Usage Effectiveness (PUE) by operating IT infrastructure with the least amount of ancillary resources, such as excessive cooling and backup systems. Ultimately, these solutions avoid wasted energy, cost, effort, and environmental impact by driving efficiencies into IT infrastructure.

Here are some practical examples of energy consumption measurements and calculations.

1. **Natural gas**. This is usually supplied through a mains pipeline network and billed in kWh. In some locations, this may be billed in cubic meters and if this is the case, it is possible to estimate the equivalent in kWh, where 1 m^3 = 11kWh (approx.).

2. **Diesel and fuel oil**. Usually purchased in litres or gallons, this is easy to convert to an estimated number of kWh. For 100% mineral diesel, the conversion rate is approx. 10.64 kWh/litre and for fuel oil, the conversion rate is a slightly higher 11.88 kWh/litre.

3. **Electricity**. Used to power ICT equipment, air conditioning and many other components of the data centre. The challenge here is to understand actual energy consumption to provide the kWh of electricity that are consumed by the data centre.

In energy production and terms, generators have different levels of efficiency based on their primary fuel and design and therefore different impacts. The main two fossil fuels used for electricity generation are coal and gas. The calculations for these are derived from the heat values for the primary fuel compared with the kWh generated.

- For coal generation, efficiency is typically around 33%-40%; this may vary due to the quality of the coal used.
- For gas generation, the efficiency is slightly higher, at over 50%.

Understanding the fuels used is important; often, electricity generating companies will publish their fuel mix over the reporting period, which will enable this calculation. Alternatively, national statistics data should be available and used as an estimate.

4. **Renewable and nuclear energy**. Theoretically, within this methodology this should be reported as zero because no primary fuels have been consumed. You may choose to report on this basis, although it is preferable to report this as a ‘decarbonised energy source’ separate to other energy; conservation of decarbonised energy is important, since this makes more decarbonised energy available for other consumers.

5. **Water**. The Green Grid, who pioneered the energy performance metric for data centres (known as the PUE), have also devised a mechanism for measuring water consumption efficiency, termed the WUE (Water Usage Effectiveness). The WUE is calculated as follows:

   WUE = Annual Water Usage (L) / ICT Equipment Energy (kWh).

   This is a sensible measure, as in theory, the more ICT equipment there is, the greater the heat generated, the greater the cooling requirement and therefore the greater the water consumption.

Energy footprint: example calculation

Let’s assume that a facility has used 1,000kWh of electricity from a supplier that has generated this using 50% gas and 25% coal and 25% renewables. The facility also consumed 200 kWh of gas and 50 litres of diesel. To calculate the footprint, we would estimate as follows:

Electricity:

Coal kWh = 500 / 33% = 1,515 kWh
Gas kWh = 250 / 50% = 500 kWh
Renewables kWh = 250 kWh

Gas:

Gas kWh = 200 kWh

Diesel:

Diesel kWh = 50 x 10.64 kWh/litre = 532 kWh

Therefore, the energy footprint is:

Fossil fuel component = 1,515 + 500 + 200 + 532 = 2,747 kWh
Decarbonised component = 250 kWh

Utilising Cloud to drive Sustainability

It's important to note that Defra's process for measuring carbon footprint starts with our ability to assess our current server estate accurately and extensively to provide a trusted and tested baseline from which we could identify the major projects and activities that can reduce our future carbon emissions. An intelligent digital and sustainability measure therefore starts with a clear understanding of the impacts of your server estate ahead of any cloud migration.

The energy consumption calculation of virtualised environments measures by single component, virtual machine and cluster of machines as well as carbon offsetting of the virtual environments. We have identified that "on demand" cloud services (those which are used only when required rather than being available all the time as they would be with our own data centres) produce less carbon emissions through a combination of factors;

- ✓ Less embodied carbon. Part of the agility that cloud brings is the ability to scale up and down as required based on actual demands on the system.
- ✓ Lower electrical consumption for each virtualised service through the avoidance of over-provisioning workloads. Therefore, using fewer servers.
- ✓ Cloud's use of more energy-efficient data centre environments.

Cloud therefore has the potential to reduce energy consumption, and in turn carbon emissions, but this must be supported by an increase in awareness by cloud consumers of how to use cloud services efficiently.

This means that we need to think of cloud services as a utility – like the electrical sockets in your home – means that your virtual environments can be configured only to be available at the times when your users need them. For example, if your personnel do not work between 18:00 in the evening and 08:00 the following morning, that's fourteen hours of energy consumption and associated carbon emissions that can be removed – a reduction of 58%. Responsible cloud service providers may go further by providing an independently validated carbon offsetting benefit, allowing your organisation to demonstrate credible corporate social responsibility from the migration of your existing IT estate to cloud-based services.

There are many opportunities to explore how cloud-based services can provide an opportunity to challenge your organisation's existing business activities – for example cloud-based document collaboration tools improve process efficiency, expedite decision making and reduce paper consumption.

Approaching net zero emissions

Net zero simply means not producing any more carbon dioxide and other greenhouse gasses.

It is possible, albeit challenging, to reach net zero using technology available today. While solutions are interlinked and complex, key elements include:-

- ✓ Reducing how much people travel within the technology sector and using ICT tools as alternatives to travel across all industry;
- ✓ Reducing energy demand with renewable and carbon neutral sources;
- ✓ Use of building standards for improving building energy efficiency and temperature controls; e.g High Passivhaus.
- ✓ Balancing demand and supply, by using smart appliances and energy storage solutions;
- ✓ Self-generation of energy.

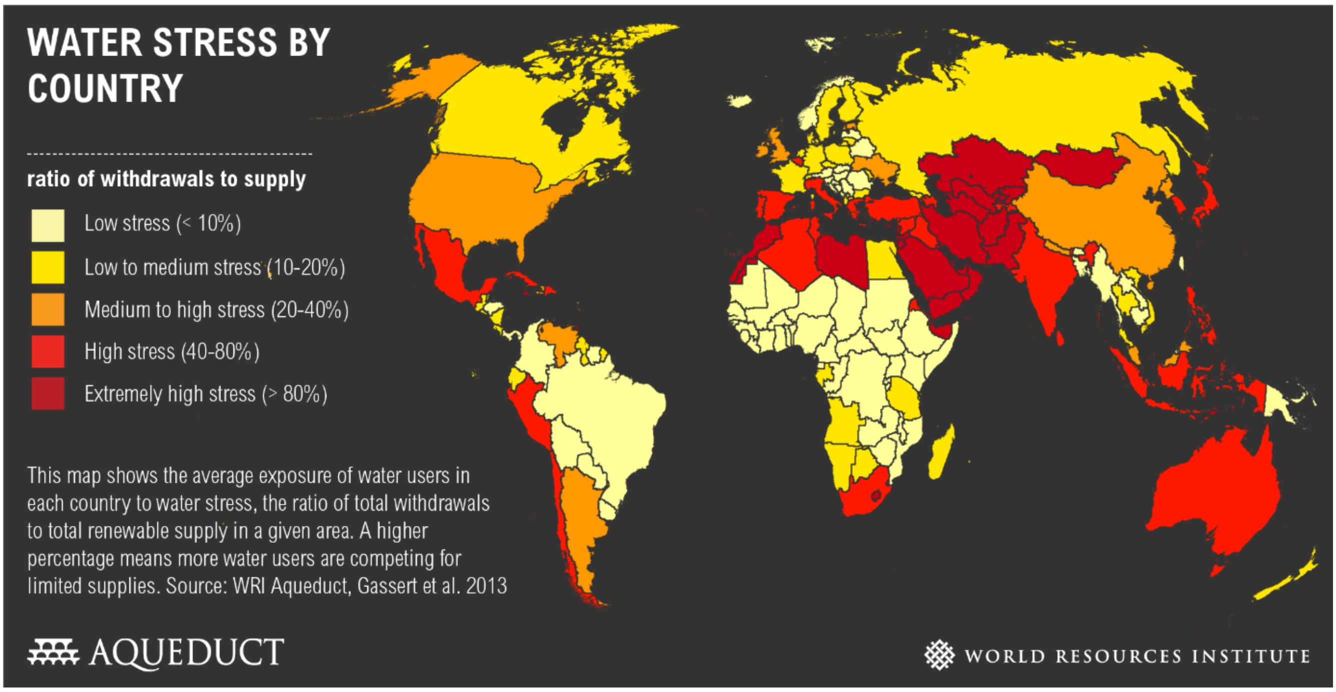
Natural water in ICT

ICT services are provided using two major resources: electrical power and water. Water usage is a major factor the operation of data centres and is used both to maintain the operating environment of the facilities, and to operate the ICT equipment contained in them. Water also forms a major part of the manufacturing of both facilities and ICT equipment

Based on socio-economics and climate change forecasts[9], it is estimated that by 2050, 55% of the world's population will be affected by water stress.

Even today, as shown in the map below, there are many places where water availability is a serious consideration. It is therefore important to measure water consumption and attempt, where practical and prudent, to reduce reliance.

[9] *Water Stress to Affect 52% of World's Population by 2050*, Water Footprint Network



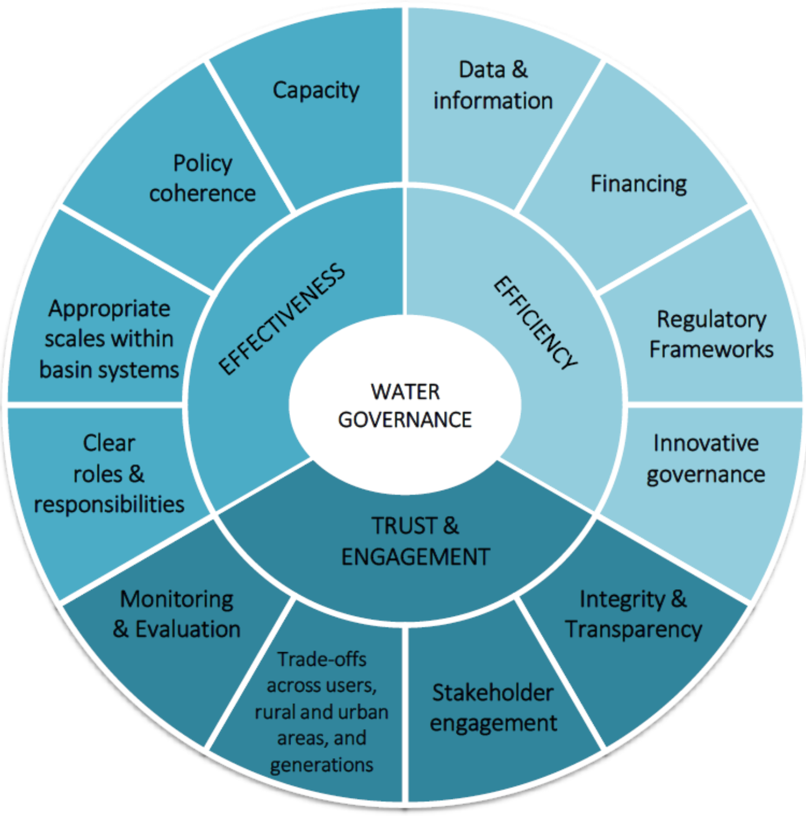
World map showing where water stress exists (courtesy of World Resources Institute, 2009)

Principles on water governance

Managing and securing access to water for all is not only a question of money, but equally a matter of good governance. The OECD principles on water governance (see below) operate on the premise that there is no one-size-fits-all solution for organisations. Rather, they are routed in broader good governance: legitimacy, transparency, accountability, human rights, rule of law and inclusiveness.

These principles are the basis for understanding the performance of water governance systems at city, basin, regional or national scales and for preparing a water risk mitigation plan.

Overview of OECD Principles on Water Governance



Preparing a water risk mitigation plan

All ICT organisations need to think about a risk management plan and a business impact analysis which are important parts of sustainability planning. Developing a water risk plan addresses many of the sustainable development goals, in particular, responsible consumption and production (SDG 12).

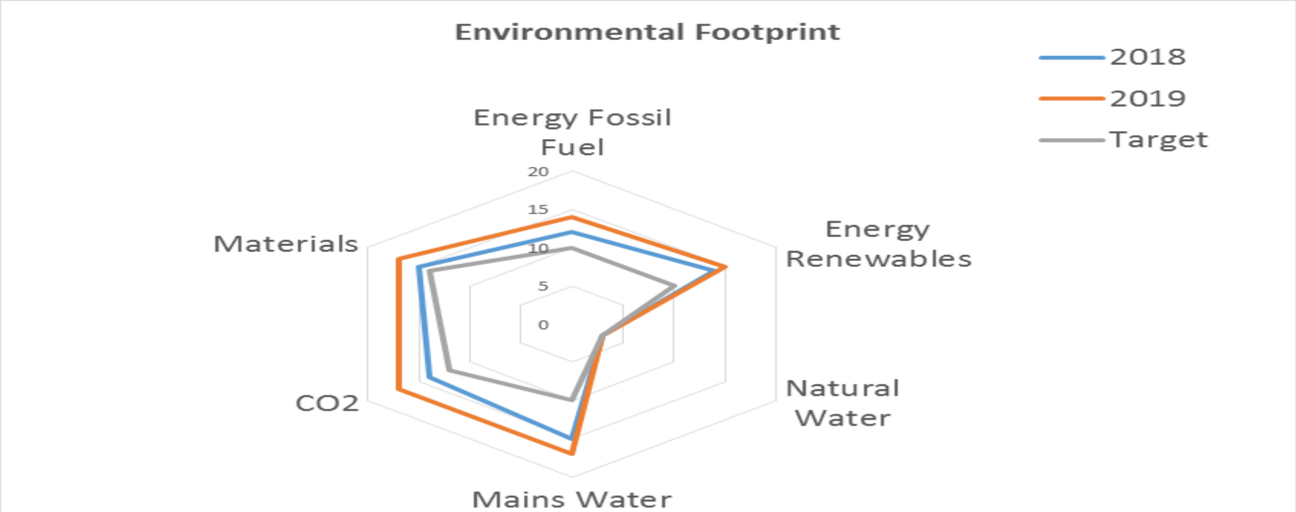
Below are the steps for organisations to take when preparing a risk management plan and a business impact analysis:-

- ✓ Step 1. Conduct a company-wide water risk assessment to determine value at risk and identify most at-risk areas;
- ✓ Step 2. Develop comprehensive water strategy and KPIs, including local action plans;
- ✓ Step 3. Implement water stewardship strategies action and collaborate with other organisations locally. The Global Water Tool[10] is a free, publicly available resource for identifying corporate water risks and opportunities; this provides easy access to and analysis of critical data.

[10] Global Water Tool, World Business Council for Sustainable Development

Reporting your ecological footprint (Internal & External)

Once all components of the footprint are measured, these can be represented using a Radar Chart, which is available within most spreadsheet applications. You may need to scale some of the values to make the chart practical, as per the example below:



Current and target ecological footprint

Conclusion

There is already a focus on carbon emissions because it is an internationally recognised measure. However, the ecological footprint is a broader set of measures and organisations should measure and score individually all components of their footprint.

Energy, water and atmospheric emissions measurements may already be in place or, if not, should become an established part of operational processes; tracking these is good practice, not least for cost management. Water-related risks should not be managed in isolation from other impacts and related trade-offs, including land use, energy consumption, and greenhouse gas emissions.

Formulating the specific methodology for carrying out the initial measurement will likely be a significant task. However, once this is complete, the process of monitoring your footprint should be more straightforward; only changes will need to be tracked for assets and physical buildings.

Efficiency measures and circular approaches will reveal more opportunities for lateral thinking and optimised solutions that break through the silos of energy, waste and water. In addition to developing mechanisms for reporting and calculation, engaging stakeholders in what they mean and driving action to make improvements is a critical activity for every organisation.

Meeting and managing ISO standards

The way in which an organisation successfully manages its activities relating to risk, compliance and standards is fundamental to its overall success.

Criteria that apply to sustainability and the environment are no different from other business measures and require a coordinated approach to ensure the desired outcomes. This is reflected in the revisions made to the ISO (International Organization for Standardization) standards relating to management systems; revisions have significantly strengthened the requirements for how organisations should monitor and act on risks and opportunities, and how they should ensure compliance with their obligations (legal, commercial or other).

The following are essential standards in the environmental and sustainability arena:-

- ISO 14001:2015 – Environmental Management Systems;
- ISO 50001:2018 – Energy Management Systems.

Ideally, systems implemented to address environmental and energy management will form part of an overarching integrated management system; this will ensure relevant input and interaction with other key areas of activities, as controlled by other systems such as:-

- ISO 9001 – Quality Management Systems;
- ISO 20000 – Service Management Systems;
- ISO 22301 – Business Continuity Management;
- ISO 27001 – Information Security Management.

Conclusion

The generic nature of ISO standards makes them applicable worldwide and to a wide range of organisations. The standards assist organisations to ensure rigour and continual improvement in pursuing ambitious sustainability objectives; they enable individuals and teams to focus on meeting concerted goals, not just to comply with siloed or mis-matching requirements.

From an ICT services perspective, ISO standards are integral to the activities that must be undertaken to ensure successful delivery to a client; process flow and responsibilities for each must be clearly defined and communicated throughout an organisation. They are equally important for ICT customer organisations to ensure sustainable use, and reuse, of ICT.

These standards are critical to accelerate the move by industry to a circular economy (see Circular economy); in this case, the various systems within and connecting organisations need to interact continuously through a virtuous circle of recycle and reuse.

The importance of ISO standards will only increase as organisations adapt and transform their processes and behaviours to meet critical sustainability goals.

Learning and Development

Sustainable development is concerned with how businesses can contribute to some of the world's most significant challenges. Organisations can only succeed if they recruit and develop staff to respond to and shape the challenges of the future.

Turning our guide into practice

Increasingly there's a need for innovation in the delivery of skills and knowledge to support organisational change, particularly in a rapidly changing external environment. Organisations can develop workforce competencies, capabilities and skills to remain successful in sustainability, through learning and development tailored for ICT personnel. Practical steps within this industry guide provide another context in which to facilitate knowledge transfer and establish corporate excellence in sustainability. Through our partner AXELOS, our work will be included as an extension to the IT service management / projects and programmes certifications. AXELOS is a joint venture between the Cabinet Office and Capita, dedicated to furthering best practice to help organisations achieve better outcomes. The AXELOS portfolio includes widely-adopted frameworks and certifications such as ITIL and PRINCE2, used by millions of practitioners world-wide. Creating a Sustainability framework aligned to these core certifications, will help support adoption of sustainable practices across a wide variety of government and private sector organisations. It provides an opportunity to reach tens of thousands of individuals each year inside and outside government, furthering the development of workforce competencies and skills to remain successful in sustainability.

Conclusion

An organisation's sustainability plan typically looks at its impact on the community locally and globally, but starts with the people behind the scenes. ICT employees at all levels need to be equipped with the sustainability skills to not only nurture innovation and manage risk, but to transform the systems within which they operate, and to deliver on broader societal goals. Focusing on building a sustainable workforce is therefore essential if a company aims to connect and deliver results authentically.

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