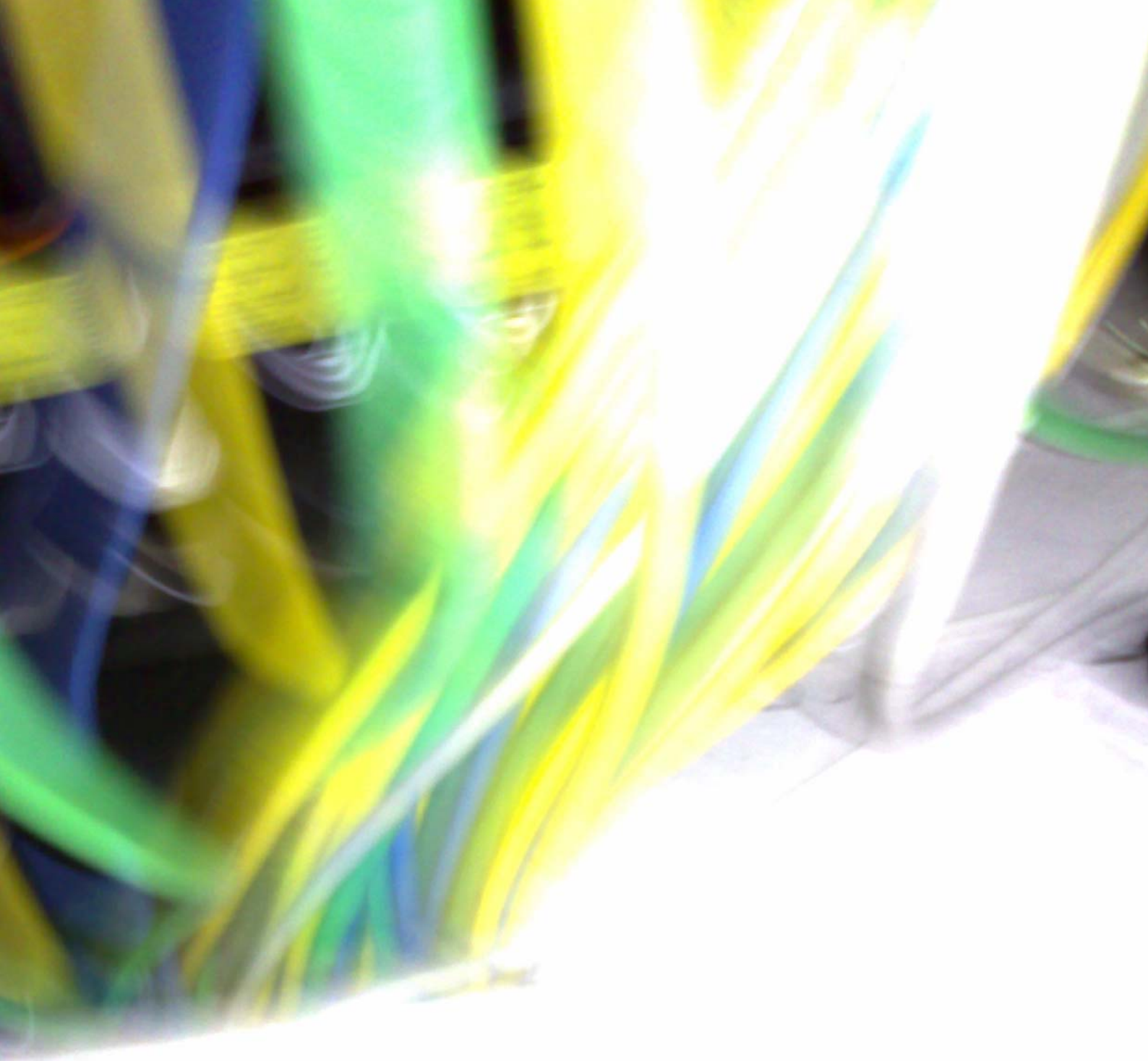

# Data Centre Carbon Reporting

## BCS DCSG review of the proposed CRC mechanism

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Confidentiality: Public

Data Centre Specialist Group http://dcsg.bcs.org

Author: Liam Newcombe

# 1 Document Information

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**Version History**

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**Release History**

## 1.3 Distribution List

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| Liam Newcombe | Author | DCSG | All |
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**Distribution List**

[1] Version numbering standard, integer number for release version, first decimal point for major revisions, second decimal point for minor revisions

[2] Roles are: Approver, Owner, Author, Contributor, Reviewer, Recipient

[3] What version should this person receive, All, Major, Minor, Release

## 1.4 About This Document

| Content Owner | Owning Team |
| --- | --- |
| Liam Newcombe | |

**Changes since last version**

Updated structure and content based upon member feedback

**About This Document**

# 2 Introduction

This document represents the review and recommendations of the BCS Data Centre Specialist Group with respect to the proposed implementation mechanism of the Carbon Reduction Commitment.

## 2.1 UK Opportunity

The current political will to implement and support the Carbon Reduction Commitment as a policy instrument, presents an opportunity for UK businesses, research and policy makers to take a world lead in developing the mechanisms, skills and technologies to deal with an economy where energy availability and environmental impact are recognised as serious factors. The CRC could demonstrate globally how consumption reduction targets can be met without damaging economic or social goals.

Unfortunately, as currently drafted the CRC is not that instrument. These goals will not be realised within the ICT sector without more mature, service consumer allocation of ICT carbon. Extensions of a UK carbon allocation market to other territories providing carbon import and export models are achievable if the CRC is restructured to work more effectively.

At present the CRC creates the incentive to launder rather than reduce carbon and rewards the organisations most adept at playing the CRC game, not those whose energy efficiency is highest

## 2.2 Scope

The goals of the CRC are neither discussed, nor questioned in this document. The risks of market distortion or perverse incentives[4] from implementation of this policy in the UK are discussed in the context of their potential impact, which includes both risks to skilled UK jobs and failure to reduce energy consumption. The DCSG recommendations seek to minimise these unintended consequences to the ICT industry and provide an effective development path and method to deliver the goals of the CRC.

## 2.3 Data Centres

Data centres present both specific opportunities and issues for a low carbon economy. Data centres consume substantial quantities of energy comparable with many manufacturing processes and yet are frequently not owned by the operator or consumer of the services and these services are highly mobile between facilities.

## 2.4 Balance of financial and league table incentives

This analysis of the CRC finds that the incentives are heavily biased toward the league table 'name and shame' reputation impacts and away from a financial impact on energy consumption. It will be far easier for an organisation to outsource their data centre and associated carbon than to address it internally.

## 2.5 Risk to UK skills and employment

The combined impact of the incentives created by the CRC driving outsourcing of ICT and data centre services both within and outside the UK is likely to reduce the number of skilled jobs in this sector as well as removing the most significant opportunity afforded by this political will, the development in the UK of world leading, exportable skills and technology in energy constrained ICT.

[4] A perverse incentive is where an incentive intended to produce one action produces an opposing or other unwanted action, for example a carbon related incentive creating a loophole where it can be cheaper to use higher carbon power.

# 3 Overview of the Carbon Reduction Commitment

This section is provided as a brief overview for readers not already familiar with the CRC.

The CRC[5] is part of the UK government activity seeking to cut carbon emissions by 80% of 1990 levels by 2050. Operators affected by the CRC will have their energy use base-lined and then be required to report their energy consumption.

The CRC appears to have been drafted with the intent that it should be easy to understand, comply with and administer. The basic mechanism for the purpose of data centre related discussion is that any organisation that consumes greater than a certain threshold of electrical energy from fixed feeds (6000MWh / year) on half hourly meters is automatically captured and all of the electrical (and some other) consumption of that organisation and all subsidiaries is totalled to represent the carbon of the organisation. The organisation then has to purchase allowances to cover the total carbon in a similar way to the power generators under the EU ETS[6]. This is intended to add direct financial incentives for the carbon associated with the electrical energy consumed by the data centre operator.

## 3.1 Who is affected by the CRC?

The CRC applies to: (from the DEFRA website[7])

*"Your organisation would be included in CRC if it has at least one meter settled on the half-hourly market – and its total half-hourly metered electricity use is greater than 6,000 megawatt-hours (MWh)* ***between 1 January 2008 and 31 December 2008****. If your organisation, including any parent company and its subsidiaries, spends more than £1,000,000 a year in the UK on electricity, you are likely to be included in the scheme."*

Simplistically, this is equivalent to a total sustained electrical load of ~685kW on half hourly meters which is well within the range of single data centres and many operators with multiple facilities.

## 3.2 Costs

From April 2010, in the introductory phase, operators under the CRC will be required to purchase allowances by fixed price sale (at £12/t$CO_2$[8]) to cover their total organisation-wide emissions. From 2013 the CRC will enter the first capped phase where there will be an auction structure for allowances and the prices are intended to rise.

## 3.3 League table

The CRC will publish a league table of all CRC participants each year starting in October 2011. There is no separation by sector; all organisations are ranked together on the league table. Position on the league table is based upon three measures[9];

1. The relative change in the organisation's CRC emissions from the baseline year
2. In the introductory phase only, an early action metrics for organisations which have put in place certain energy saving measures
3. A growth metric which takes into account the growth (or reduction) in emissions per unit turnover

[5] DEFRA website http://www.defra.gov.uk/environment/climatechange/uk/business/crc/index.htm

[6] EU Emissions Trading Scheme http://ec.europa.eu/environment/climat/emission/index_en.htm

[7] CRC, Who's affected http://www.defra.gov.uk/environment/climatechange/uk/business/crc/scope.htm

[8] This is the initial, fixed $CO_2$ price within the first phase of the CRC, see page 34 section 4.2.1 of the user guide

[9] See pages 40-42 of the CRC user guide

## 3.4 Revenue Recycling

The bulk of the revenue raised by the sale of allowances is paid back to the CRC qualifying operators under the 'revenue recycling payments' scheme. The allocation of payments is based on both the organisation's share of the total CRC emissions in 2010/2011 and an adjustment based upon their performance in the league table. An organisation may receive more or less than their original CRC payment under revenue recycling. This is intended to provide a direct financial incentive to reduce energy consumption.

## 3.5 Further information on the CRC

DECC has recently published a user guide to the CRC[10] as well as transferring the CRC information to the DECC website[11].

## 3.6 Constraints

Whilst the CRC as currently drafted might fairly and reasonably include data centre electrical energy where those data centres are operated by the organisation using the services provided, this is not a general case and the CRC risks driving further separation of the data centre from the organisation whose activities it supports.

At present there is no mechanism for a organisation captured under the CRC to allocate carbon to another organisation based on indirect energy use through data centre or other service demand. This might take place at three conceptual levels;

1. Cross allocation between CRC captured companies to 'contain' the carbon
2. Cross allocation to any other UK organisation, this presents the risk of sub CRC threshold carbon sink companies
3. Cross allocation to any other organisation, including overseas, this again presents the risk of carbon sinking but could be operated in a similar manner to VAT and deliver an effective supply chain analogue, Carbon Added Tax (CAT)

[10] CRC user guide

http://www.defra.gov.uk/environment/climatechange/uk/business/crc/pdf/crc-userguide-090312.pdf

[11] DECC website http://www.defra.gov.uk/carbonreduction

# 4 Summary

This summary describes some of the basic issues of the CRC as proposed, in the specific context of ICT and data centres. The aspects that make data centres a distinct sector are presented, followed by discussion of the CRC impact on data centres and its lack of alignment with other, UK and worldwide data centre and energy policy activities.

## 4.1 What is special about data centres?

Data centres are unusual in a number of ways as compared to most of the other energy consuming activities targeted by the CRC.

- Data centres are a horizontal not a vertical, they do not usually deliver an actual output of the organisation but provide supporting or enabling services to other business activities
- Data centres are energy intensive, figures from the US EPA[12] and UK government[13] place data centre energy consumption on a par with aviation and rising more rapidly than most other sectors.
- For many organisations the data centre is a substantial part of their overall operating energy consumption
- A large part of the operating cost of a data centre is the power bill, this is already uncompetitive in the UK, the addition of substantial carbon costs may present a significant deterrent to operation within the UK regulatory zone
- Data centres can be operated from or located in almost any remote location, in any language, with a minimum of, relatively unskilled, local staff whilst still delivering all of the required services transparently to the user. This is quite distinct from manufacturing processes.
- The location from which data centre services are delivered can be changed rapidly with relatively little disruption or risk
- A data centre can be easily 'outsourced' to another operator and the services continue without disruption
- Data centres already do, and can continue to, play a key role in the reduction of the other 9x% of carbon emissions

## 4.2 The CRC achieves only partial coverage

Whilst the CRC is presented as being inclusive of all of an organisations emissions responsibility through energy consumption the reality is quite the opposite. The CRC does not target the energy consumption or efficiency of an organisation but simply the physical assets it directly owns or operates. The CRC does not capture the resources 'owned' through contracts. This basic issue is the source of most of the perverse incentives created under the CRC. Further, this partial reporting is a direct driver toward more complex company and contract structures to offload carbon responsibility.

[12] EPA Data Center Report to Congress, www.energystar.gov/ia/partners/prod_development/downloads/EPA_Datacenter_Report_Congress_Final1.pdf

[13] DEFRA UK Market Transformation Programme

## 4.3 The CRC league table

The league table is an apparently simple mechanism for the processing and comparison of the carbon reported by each CRC organisation. Unfortunately this mechanism becomes very complex, difficult to forecast and difficult to understand once applied to all of the CRC organisations across each of the sectors in which they operate. It will be sufficiently difficult to properly understand the change in one organisation's league table score that comparison with other organisations will be complex and of very limited utility. Whilst the data collection and administration of the league table is relatively simple the external value of the league table is open to serious question along with its suitability for controlling the revenue recycling payments.

The league table is based (75% weight) upon change in the 'absolute metric' which measures an organisations CRC reported carbon with a 'growth metric' representing change in turnover (25% weight) to provide some compensation for growth.

### 4.3.1 Issues with the league table structure

There are a number of issues with the league table structure which are particularly hard to reconcile in the ICT sector.

#### Multiple services

Where an operator has multiple services, such as collocation and managed services their total carbon is the sum of each of these activities. Where we consider the growth metric we need to examine instead the carbon intensity by turnover ($CO_2$ / £) which is the sum by fraction of the intensity of all turnover generating activities.

| Service | Colocation | Web Hosting | Email | CRM | Total |
|---|---|---|---|---|---|
| Turnover | £1,000,000 | £1,000,000 | £1,000,000 | £1,000,000 | £4,000,000 |
| Carbon | 1,000,000 | 300,000 | 200,000 | 100,000 | 1,600,000 |
| CO2 / £ | 1.00 | 0.30 | 0.20 | 0.10 | 0.40 |

**Table 4-1 Example total CO2 /£**

The example simplistic representation of a data centre operator in Table 4-1 shows that the $CO_2$ / £ of their services varies by a factor of 10 between collocation and managed CRM applications.

#### Maintaining league table score

To maintain the same score in the league table an organisation wishing to grow their consumption as part of business growth must generate revenue with product(s) or service(s) which exhibit four times their overall $CO_2$ / £ intensity. This is irrespective of their relative efficiency against any other organisation. For the example operator above in Table 4-1 this means that CRM is the only service that the 25% weighted growth metric would allow them to increase business in without penalty. It is unlikely that their collocation services are less than 25% efficient and as such, in a commoditised market this operator cannot expand their collocation services, however efficient they become compared to their current state or other operators without being penalised and suffering a lower league table ranking.

Mergers and acquisitions between organisations will create interesting effects here.

This issue would not be mitigated by a 100% weighting for growth as this would still assume that all turnover generating activity was of the same carbon intensity per unit turnover which would be naïve.

Comparing or maintaining a relative score in the league table against other operators whose mix of services is different will be even more difficult and less informative.

### Rewarding late action

Organisations which have already undertaken energy efficiency measures are at a substantial disadvantage as the high gain ($CO_2$ / £) quick wins that others will use to 'improve' their league table performance have already been spent.

### The league table is not an indicator of carbon efficiency

Where there are CRC organisations in the league table who act in multiple sectors the position of any operator in the table is not an indicator of their carbon efficiency as different types of activity have different intrinsic revenue to energy ratios. The complexities of the growth issue further restrict any value as an indicator. This should be clearly marked on the league table whenever it is published.

### League table position is of no value in supplier selection

Due to the inclusion of all activities, the failure to include contracted activities and the issues of the growth metric, the CRC league table position is of zero value or actively misleading if used as a guide to procurement of goods or services. The CRC should publicly advise that the league table is not suitable for use in procurement.

## 4.4 Other policy activities

The CRC seems to run counter to many existing and successful policy instruments. Many of these current instruments work at either the supply or consumption end of the chain.

Supply side mechanisms such as EU ETS apply a direct additional cost to the supply of the resource being constrained, in this case carbon emitted to produce energy, thus allowing the market to effectively reflect the impact of energy cost through the entire chain. This mechanism inherently survives the market changes in process, technology or structure it creates as supply price and demand change together and allows the market to seek a new equilibrium state.

Demand side mechanisms such as the A-G labelling of domestic white goods and the Energy Star programme work by informing the consumer of a product or service of the relative efficiency and costs, thereby changing demand based upon the factors they wish to influence. This change in demand pattern influences supply behaviour.

CRC is neither supply nor demand, it does not work across any entire sector, it targets a subset of operators across many sectors and applies a partial cap.

## 4.5 Obstructing ICT efficiency improvements

The CRC, by failing to capture any energy not directly billed to each organisation creates strong incentives to separate and stratify the supply of ICT. This is a significant obstruction to many existing efforts to improve the efficiency of ICT, particularly in data centres. Data centres work as a system which requires effective communication, planning and mapping of requirements between disciplines, from the business applications to the mechanical plant to achieve the available efficiency improvements. Other policy activities such as the EU Code of Conduct for data centres recognise this and specifically avoid measures or targets that would work against this. The CoC contains measures specifically designed to try and close the communication gaps that have created inefficiencies; the CRC directly works against this by reinforcing a segmentation of responsibility.

## 4.6 Polluter pays

The CRC, by generating these incentives to outsource carbon, risks violating the 'polluter pays' principle and being seen as the carbon equivalent of musical chairs with some organisations happening to be in more advantageous positions than others when the qualification period stops.

## 4.7 The CRC may work against the goal of carbon reduction

ICT has the potential to substantially reduce net carbon emissions and deliver an essential part of the overall targets. If simplistic reporting guidelines of the type proposed for the CRC are implemented for data centre energy consumption the perverse incentives created by the CRC risk distorting the data centre market in such a way these efficiency improvements in other sectors are compromised. This presents a linked risk to both skilled UK jobs and long term UK innovation. See section 6.1 for further information.

## 4.8 The current mechanism will consolidate carbon ownership

The current measures directly reward organisations outsourcing their energy intensive data centres under both the absolute and growth metrics. This creates a pressure to move data centre carbon to a small number of providers who are not concerned by a poor league table position. This will not be mitigated by the risk of being identified as having outsourced simply to remove the data centre carbon as these contracts can take many forms and managed services are a common aspect of business. An incremental pressure also exists upon the creation and delivery of new services, rather than CRC delivering the constraint of driving the removal or efficiency improvement of older services to release available carbon, new services are more likely to simply be placed with an external agency.

## 4.9 The current mechanism drives data centre carbon off-shore

The current measures, through both direct financial and league table reputation impacts are likely to drive the off-shoring of data centres, services and associated carbon. This takes both the net energy consumption and energy efficiency of data centres outside of the control of the UK and the CRC.

# 5 Recommendations

Based upon assessment of the draft CRC the following summary recommendations are made;

## 5.1 ICT energy use should be considered in context

To allow ICT to deliver the assistance it is capable of in reducing overall carbon emissions the energy used by an ICT service must be considered in a realistic and credible context as part of the overall carbon of the process it supports. Failure to apply the ICT service carbon to the consumer of the service prevents this taking place and creates a substantial set of perverse incentives which are complex and almost impossible to mitigate.

## 5.2 Data centres should be excluded from the CRC until effective allocation mechanisms are available

If simplistic allocation of data centre carbon to the owner of the building rather than the service consumer, as proposed in this document, is adopted, then data centres should simply be excluded from CRC until such a time as more advanced mechanisms are available.

A potential fall back mechanism to partially mitigate the issues would be for an organisation's data centre electrical energy to be covered by the CRC requirement to purchase allowances, but excluded from both the league table and revenue recycling calculation methods. The league table provides significant short term perverse incentives and presents the risk of market distortion.

### 5.2.1 Development roadmap

A development roadmap for data centre energy reporting is recommended which will allow the CRC to globally lead the development and implementation of effective ICT energy reporting whilst mitigating the perverse incentives, market distortion and loopholes created in the short term.

| Stage | Description | Coverage |
|---|---|---|
| **Stage 1** | Coarse estimates | Device level allocation,<br>Dedicated IT hardware only |
| **Stage 2** | Drawn and Provisioned power | Device level allocation,<br>Dedicated IT hardware only |
| **Stage 3** | Simple Service Allocation | IT services allocation,<br>Based on Stage 1 or 2 hardware allocation |
| **Stage 4** | Real Per Service Allocation | Effective, fair and reasonable allocation of the energy consumption |

5-1 Allocation development roadmap

## 5.3 The landlord tenant relationship should be reviewed

The landlord tenant breakpoint in the CRC is responsible for many of the perverse incentives to the ICT and probably other markets. This should be reviewed and mechanisms of allocation developed to drive the energy aware behaviours that are required.

## 5.4 Mitigating the perverse incentives though clear policy direction

A clear policy statement from DECC to the market stating that the medium term goal is to develop reporting and allocation mechanisms for services, including ICT would mitigate the attraction of short term carbon laundering measures.

# 6 Discussion of the CRC

The CRC was discussed at the February 2009 members meeting of the Data Centre Specialist Group. This section of the document outlines the discussion including the identified risks, opportunities, loopholes, outstanding questions and initial recommendations.

## 6.1 ICT energy reduction in other sectors

The EC has already stated that it expects intelligent application of ICT to be able to reduce carbon emissions by 15% across the Eurozone by 2020[14], also NGOs such as the World Wildlife Fund[15] are promoting ICT as a solution to climate change and advocate more carbon "credits' for ICT. This ability to leverage ICT to deliver substantially larger energy reductions in other sectors is a key tool in meeting overall carbon reduction targets.

## 6.2 Stages of CRC impact

It appears that the CRC will have two distinct stages of impact on the UK data centre sector based upon the direct financial and reputation or brand impacting aspects. The direct financial impacts are negligible at the currently suggested prices of carbon, whilst the impact of the public league table will be substantial for certain types of operator.

### 6.2.1 League table impacts

The first stage of impacts to the data centre markets is likely to be the annual publication of the league table of CRC reporting operators. This league table will be public and will have a direct impact on an organisations 'green' image. This will, for some operators, have a direct effect upon brand value and customer behaviour which these operators will be keen to mitigate.

### 6.2.2 Direct financial impacts

With a starting price of £12 per tonne of $CO_2$ the initial financial incentives are quite weak and are unlikely to drive any significant change in behaviour.

| Element | | | | Cost |
|---|---|---|---|---|
| CRC Allocations | 0.537 kg /kWh | 0.537 kg | £12 / tonne | £0.0064 |
| Revenue Recycling | | | 50% | -£0.0032 |
| Energy Cost | | | £0.08 / kWh | £0.08 |
| Total | | | | **£0.0832** |

**6-1 Comparative cost of CRC payments per kWh 2010/2011 rates**

As shown in table **Error! Reference source not found.** the total impact of the CRC on the power cost is sufficiently small that supply price volatility is a far greater concern.

[14] "ICT can reduce annual global emissions by 15 per cent by 2020 and deliver energy efficiency savings to global businesses of over EUR 500 billion" - Global e-Sustainability Initiative, SMART 2020: Enabling the Low Carbon Economy in the Information Age, June 2008

http://www.gesi.org/index.php?article_id=210

[15] ICT solutions that can help to reduce CO2 emissions
http://www.panda.org/about_our_earth/all_publications/ict/information_technologies_climate_change/

#### Incentives and Perverse Incentives are intrinsically linked

As shown the initial direct financial impact of CRC will be small enough that it will have little impact and the effects will be dominated by the league table. For the CRC to be effective there must be the expectation that prices of carbon on the EU ETS and under CRC reduced allocation auctions will rise. This will make both the intended and the perverse incentives more significant at the same rate.

## 6.3 Potential Issues

The Data Centre Specialist Group was asked by a number of members and interested third parties to provide feedback to DEFRA and DECC on the CRC reporting guidelines with specific reference to identified potential issues. It is important to bear in mind that the UK economy is highly 'knowledge based' and that the ICT sector is a key contributor to this knowledge economy. Due to the unusual nature of data centre based ICT services it will be very easy to drive these services out of the UK economy damaging our ability to earn, innovate and develop lower carbon technologies and solutions.

### 6.3.1 Market distortion

Under the basic operating mechanism of the CRC the parent organisation acquires the obligations for all of the energy used by subsidiaries. Under this approach the opportunity for 'carbon laundering' of data centre emissions is created. This market distortion specifically rewards companies outsourcing their ICT services or data centres whilst penalising UK based outsourcing companies. Further, this effectively raises an, initially small, tax on outsourcing of ICT by small companies who, potentially, have more to gain in energy efficiency through outsourcing.

Further there is the risk, through the dominant absolute emissions mechanism, of fixing the market with the established players at their current relative sizes through both league table and later direct financial impacts. This may obstruct competition and actively suppress new businesses.

The reputation impact of the CRC for many IT companies who have expended substantial effort in developing an environmental position will be substantially negative.

Both the absolute and growth factors in the league table reward outsourcing a data centre. Due to this, the data centre sector risks become a dumping ground for embarrassing corporate carbon with collocation operators at the bottom with end user companies, managed service providers and outsourcers divesting themselves of the physical facilities. Name and shame is the incentive for this action, so the small additional costs of outsourcing to an operator lower in the table are very unlikely to affect this trend until carbon costs rise by at least 10x.

*A fundamental issue with the disconnected allocation mechanism where the carbon is attributed neither to the energy supply nor the user demand, but an entity in the chain is that highly efficient commodity service will be rated as less 'green' than high cost services run from lower efficiency data centres.*

### 6.3.2 ICT energy requires context

As the goal of the CRC is to reduce overall carbon emissions ICT energy consumption should be considered in a broader context. A myopic focus on data centre energy use in abstraction from the broader business will not create the internal or external markets which would effectively determine the carbon 'price' for an ICT service and drive the available improvements both within and due to the use of ICT. To avoid obstructing these developments it is recommended that the ability to effectively allocate carbon to the delivered ICT service is developed so that the ICT energy consumption can be directly weighed as part of the process level assessment.

### 6.3.3 Import and export of services

The UK claims of improved economic carbon efficiency have already been criticised over the effective offshoring of much of the embodied manufacturing energy to countries such as China. A study commissioned by DEFRA in 2008 concluded that in addition to the internal 620Mt[16] $CO_2$ the UK is responsible for an additional 105Mt through imports[17].

As currently constructed the CRC generates an incentive for organisations to also offshore their in use carbon by procuring ICT services from data centres outside of the CRC and therefore the UK. There is no significant technical or logistical obstruction to this and the practice is already gaining popularity. As UK operators will bear additional financial and image burden for services delivered to UK or overseas companies, the CRC risks imposing an anti-competitive, inverse protectionism, penalising operators who remain in the UK against overseas operators providing the same services at the same or lower carbon efficiency.

## 6.4 CRC risks

The risks of the CRC were discussed as a precursor to discussion of the required scope and recommended reporting and allocation mechanisms.

### 6.4.1 Market distortion

Under the basic operating mechanism of the CRC the parent organisation acquires the obligations for all of the energy used by subsidiaries. This creates a broad range of unintended and potentially damaging secondary effects in the data centre market. These secondary effects are particularly significant in a market where energy efficiency is being rapidly adopted due to the rising proportion of operating costs which are directly related to energy consumption and brand value impact of a companies 'green' status.

Each of these effects is categorised by its sensitivity to league table or direct financial incentives.

| Effect | League table | Direct financial |
|---|---|---|
| **Carbon laundering** | High | Low unless carbon price rises 10x or more |

Under this approach the opportunity for 'carbon laundering' of data centre emissions is created. Any organisation concerned with brand value and therefore sensitive to their position on the league table would be very well served by selling their data centre to an outsourcer or 'service provider' entity which would operate the data centre and pay the power bill, the original operator would then purchase a 'service' which comprised the original data centre whilst the carbon was left with the 'service provider'.

This carbon outsourcing both reduces the companies' absolute emissions metric whilst also improving their $CO_2$ / turnover measure, resulting in an improvement in both long term CRC measures for no net reduction in carbon emissions. The financial incentives as currently set out are unlikely to be sufficient in the short or medium term to mitigate this incentive.

This distortion alleviates the most significant short term, reputation based, lever on large brands, directly harming the goals of the CRC.

[16] Parkinson, S: "UK climate strategy – are we making progress" in SGR Newsletter, Issue 36, Autumn 2008.

[17] Wiedmann et al: Development of an embedded carbon emissions indicator. Report to DEFRA by Environment Institute of Stockholm, University of York and Centre for Integrated Sustainability Analysis, University of Sydney, June 2008.

| Effect | League table | Direct financial |
|---|---|---|
| **Market stratification** | High | Low unless carbon price rises 10x or more |

A further impact of the carbon laundering effect is likely to be market stratification.

For the same reason that an owner operator concerned with their brand value should push their data centre down the stack to an outsourcer or managed service provider, these managed service providers should also, after being benchmarked, divest themselves of their data centres to a collocation provider in order to protect substantial investment in 'green' corporate positioning strategies.

This presents an opportunity for a small number of providers to set up to take on data centres at the bottom of the chain and work as carbon sinks, absorbing the reputation impact that other players wish to avoid. A low position on the league table would actually be a sales feature for such an operator.

| | | |
|---|---|---|
| **Disincentives to new business** | Medium – High | Initially low but rising with carbon price |

A further issue under the simplistic approach is that the structure of league tables, targets and fines will fail to deal with the acquisition and loss of contracts by data centre operators, thus creating incentives against acquiring new business for successful and efficient operators. Specifically an operator whose business is successful and acquires new customers will bear additional costs under the CRC which they would have to pass on to the new customers in the form of service fees, making them less competitive than an operator who has lost business since their baseline year. This could directly affect competitive tender by impacting pricing based on an effectively arbitrary factor.

These operators would be further penalised by falling further down the league table, irrespective of their efficiency relative to their peers as the revenue growth mechanism provided in the CRC only allows for 25% of the league table calculation.

| | | |
|---|---|---|
| **Outsourcing tax** | Low | Initially low but rising with carbon price |

Where outsource service providers are targeting businesses who do not come under the CRC the acquisition cost in allocation purchase at auction and potential fines presents what is, in effect, a new tax on outsourcing. One of the core arguments of many of these outsource providers is that they possess the skills, expertise and economy of scale to run commodity ICT services at much higher efficiency than Small to Medium Enterprises. This issue may persist if cross allocation of carbon is allowed but only between companies registered under the CRC.

| | | |
|---|---|---|
| **Market stagnation and obstruction of competition** | Medium | Initially low but rising with carbon price |

The simplistic allocation approach will be to make it more difficult for any new entrant to the market, whether or not they are more efficient than the established operators, as they will be persistently lower ranked and charged more under CRC for operating a growing business, even if more efficient than established competitors.

| Effect | League table | Direct financial |
|---|---|---|
| **Competitive status** | Medium | Initially low but rising with carbon price |
| Utility power in the UK is already significantly more expensive than in many other European states and has now become a significant part of the overall cost of ICT services delivered from a data centre. Power is the dominant operational cost for collocation facilities. With the additional risk cost of CRC charges rising in later years and the reputation damage there is now a strong economic argument to build new data centres for UK operators in locations with lower power costs and regulatory burdens such as Poland and the Czech Republic whose grid carbon intensities are much higher than the UK | | |
| **Driving further inefficiency** | High | Falling with carbon price |
| Many operators of shared data centres are constrained in their ability to implement efficiency improvements by customer objections to change or perceived risks and have little ability to influence these decisions.<br>An example of this is a collocation operator who wishes to implement air flow management and increase the operating temperature of the data floor to reduce their cooling losses which are the dominant inefficiency in most data centres. If a single customer in the space refuses to allow this work and change to go ahead then this prevents the operator implementing that change for any customer. | | |
| **Outsource new services** | High | Falling with carbon price |
| The CRC, by driving internal carbon budget constraints which can be easily avoided by outsourcing of the service removes the strong incentive of such budgets to eliminate or reduce the energy consumption of legacy services to free 'carbon capacity' for new. This would have substantial secondary effects on the demand for skilled architect level staff in end user organisations. | | |

**Table 6-2 CRC Market distortion risks**

### 6.4.2 Risk to UK jobs

In addition to relocation of existing or new data centres outside of the UK (or EU), the transfers of ownership identified above would present a substantial risk to UK skilled jobs within the ICT sector. In a data centre it is easy and relatively quick to remove UK based staff and replace them with resource from a cheaper territory who remotely manage the facility or the services provided from it with a minimum of local resources. The remaining local resources will tend to be the lower skilled. This is an established approach for outsourcing companies wishing to optimise their margin and frequently takes place where staff are transferred as part of the arrangement with the outsourcer accepting the redundancy burden. Unlike many other sectors this can be quickly achieved in the data centre without moving the data centre itself or the associated emissions outside the UK.

### 6.4.3 Development roadmap

Whilst an increasing proportion of data centres (and therefore CRC targeted energy consumption) are operated by service providers rather than the service consuming organisations, the measurement and reporting of ICT energy consumption is not yet mature. Neither the science nor the metering and reporting systems necessary to deliver effective or relevant, service based, ICT energy reporting are yet available.

This presents a significant issue as current capability dictates simplistic protocols which would create long term perverse incentives weakening the CRC. Without an identified development roadmap for ICT such as for the broader CRC it will not be possible to move to appropriate and effective allocation of the share of energy consumed by an ICT service.

### 6.4.4 ICT energy requires context

As the goal of the CRC is to reduce overall carbon emissions ICT energy consumption should be considered in a broader context. Only a small proportion of data centre delivered services are parts of an ICT only final product, most form part of a business process whose energy impact may be substantially greater than the ICT energy used in supporting it. Further, the ICT sector presents a substantial opportunity to use technology to reduce the greater emissions elsewhere.

To avoid hampering the ability of ICT services to reduce carbon elsewhere it is recommended that the ability to allocate carbon to the delivered service is developed so that the ICT energy consumption can be directly weighed as part of the process level assessment. This is increasingly important with the distributed, multi-party nature of data centre based services and the development of internal carbon accounting and budgeting within large organisations targeted by the CRC. A myopic focus on data centre energy use in abstraction from the broader business will not create the internal or external markets which would effectively determine the carbon 'price' for an ICT service and drive the available improvements both within and due to the use of ICT.

# 7 ICT carbon reporting

A significant part of the discussion was on the topic of how effective protocols for carbon reporting could be developed, over what implementation timeframes and how they could be constructed to create incentives for accurate reporting.

## 7.1 Areas of activity to capture

The following basic areas of activity were identified as important to capture within any reporting recommendation.

### 7.1.1 Whole building

Where a organisation has a dedicated data centre and are the sole user of the building which is run as a dedicated facility, the energy consumed by this data centre should be allocated to, declared by, and subject to targets, fines and bonuses for the organisation and not a third party.

### 7.1.2 Colocation

Where a organisation has ICT equipment in a shared data centre (referred to as collocation) a fair and reasonable share of the energy consumed by the data centre should be allocated to the organisation by the operator of the data centre.

### 7.1.3 ICT services – dedicated hardware

Where a organisation procures ICT services based upon managed, but dedicated to that customer, IT hardware, a fair and reasonable share of the energy consumed by the data centre housing that hardware should be allocated to the organisation by the operator of the data centre.

### 7.1.4 ICT services – shared hardware

Where a organisation procures ICT services based upon managed, shared across a number of customers, IT hardware, a fair and reasonable share of the energy consumed by the data centre housing that hardware should be allocated to the organisation by the operator of the data centre.

## 7.2 Loopholes to close

There are a number of obvious loopholes when attempting to devise a mechanism to allocate the energy use and therefore carbon from a data centre or data centre based ICT service.

### Sell and lease back as a service

The simplest approach to defeating the simplistic allocation to the organisation which pays the utility power bill is to sell the data centre to a third party and lease back a data centre 'service'. This is described more fully in Table 6-2.

### Carbon outsourcing

Outsourcing a corporate data centre or entire ICT department would, under the current allocation approach result in the carbon also being outsourced. This is described more fully in Table 6-2.

### 50/50 Ownership

There is an apparent potential flaw in the CRC wording of 'highest parent organisation' in that a facility that was owned and operated by a joint subsidiary of two organisations with equal 50% shareholding would technically not be attributable to either organisation.

### Shared facility trick

Under a more complex allocation mechanism where multiple tenancy or multiple use is recognised there may develop a loophole whereby an operator could host a single or small number of devices for another organisation within their data centre and thus claim that it is a shared facility and that they should be able to allocate on a different basis to wholly occupied. A maximum threshold for a single organisation within a facility would control this issue.

### Recognition of reserved capacity

It is well known that a data centre exhibits a substantial fixed overhead energy consumption and that this is based upon the design efficiency and the rated IT capacity of the building. Companies that reserve space and power in a shared data centre are effectively occupying part of that shared overhead and should therefore have it allocated to them. This practice also drives the construction of new data centres before existing capacity is utilised.

### Allocation based on PUE[18] multiplication of metered power

Simply multiplying the metered power of an IT device in a data centre by the PUE (Total utility power / Total IT power) of the data centre does not represent the utility power that should be allocated to a device. This approach does not distinguish between the fixed and variable energy use in the data centre and would create a range of perverse incentives.

### Marginal power tricks

Once the split between fixed and variable energy use is understood in the data centre some operators may consider it advantageous to allocate the energy for certain devices, customers or services as the marginal (variable) energy for the service and sink the appropriate share of fixed overhead elsewhere, e.g. another customer.

### Repackaging as 'services'

A reporting protocol which required data centre energy to be allocated based on the ownership of the IT equipment would be immediately vulnerable to repackaging mechanisms transferring ownership and repackaging the IT equipment as a service (HaaS).

### Temporary buildings

Clarification is sought from DECC that a temporary building running from a utility electrical feed is not exempted from the CRC targets and reporting. This would result in a rapid conversion of the market to 'containerised' data centres to avoid inclusion.

### Combined cooling and power systems

Under a scheme where membership thresholds are set on the half hourly metered electrical load there will be a very strong incentive for operators to build local CCP systems powered by light oil or gas. Whilst this type of generation offers some achieved efficiency advantages these have already been factored into other legislation and this class of facility should not be completely exempt from CRC reporting unless there is a specific policy decision to force the market in this direction. This would place significant pressures on local planning authorities as data centre operators and builders sought permission for a CRC exempting local CCP plant.

Further, the available efficiency benefits through combined cooling and power are rapidly reducing as the use of economiser technology increases and IT equipment operating environmental conditions are expanded.

[18] Power Usage (in)Effectiveness, a Green Grid metric describing the power transfer (in)efficiency of a data centre, this is a popular metric within the industry.

## 7.3 How to allocate data centre carbon

A significant part of the discussion was on the topic of more rational and effective methods of carbon allocation for data centres. A number of important points were raised regarding the requirements and preferred outcomes;

- The CRC needs to be presented to the industry as an opportunity to improve and not a market distorting set of regulations, costs and brand value impacts
- The CRC should assist companies and government in understanding the role of ICT in the bigger picture of overall energy use
- There should be incentives for operators to move 'up' the scale of reporting granularity and accuracy, these could be based upon commercial or reputation measures

### 7.3.1 Principles

The discussion covered four basic levels of carbon reporting capability and their relative merits, the basic principles underlying these allocation mechanisms are;

#### Allocate all of the carbon

Each mechanism requires the entire carbon of a data centre to be allocated to either, the operator or their customers, no carbon should be discarded or lost in the process.

#### Allocate the carbon to the demand side of the relationship

In order to direct the carbon incentive to the organisation using the ICT systems and creating the demand for energy consumption the carbon should normally be allocated to the demand side of a commercial relationship boundary e.g. in an outsourced single occupant data centre the entire carbon should be allocated to the occupant and not the data centre operator.

#### Allocations should be fair and reasonable

Where choices are available in allocation mechanisms the option that results in the more fair and reasonable allocation should be chosen.

#### Flexibility and discretion will be necessary in the lower stages

Due to the lack of both agreed method and measurement capability for ICT services some flexibility in the mechanism and discretion on the part of the service operator will be necessary in the lower stages e.g. a shared email service platform may allocate on a per user basis by simply dividing the total carbon of the platform across the user basis.

### 7.3.2 Stage 1: Coarse estimates – dedicated hardware

The simplest level of allocation is to divide up the data centre utility energy by some coarse estimate of the share of the overall energy consumption. This allocation mechanism is for dedicated IT equipment whose power can be assigned to a single customer of the data centre. The energy allocated to ICT equipment owned by the operator and used to deliver a service is allocated to the operator and not to customers. A number of options were presented, each with advantages and disadvantages;

| Allocation option | Advantages | Disadvantages |
|---|---|---|
| **Rack count (or floor area)** | Simple and easy to achieve | Does not differentiate on allocated capacity or consumed energy |
| **Estimated device power draw** | Differentiates on consumed energy | Does not recognise fixed overheads or reserved capacity.<br>Estimates of device power draw may require substantial effort. |
| **Rated device power draw** | Differentiates on consumed energy | Does not recognise fixed overheads or reserved capacity.<br>Estimates of device power draw may require substantial effort. |
| **Metered device power draw** | Differentiates on consumed energy | Does not recognise fixed overheads or reserved capacity.<br>Metering equipment not present in many facilities. |
| **Provisioned power** | Recognises fixed overhead and reserved capacity<br>Relatively simple to achieve | Does not differentiate on consumed energy |

**7-1 Stage 1 allocation**

None of these options is particularly fair and all create some mixed incentives, they are, however, a substantial improvement on the allocation of the entire building power to a single operator. None of the options given above is substantially better than any other.

### 7.3.3 Stage 2: Provisioned and drawn power – dedicated hardware

Recognising that the fixed energy consumption of a data centre can be a substantial proportion of the overall energy use, a more advanced stage was proposed utilising this knowledge. Both the allocated power and cooling capacity and the drawn energy by devices are used to determine the allocation of the share of the total utility energy. This allocation mechanism is only suitable for dedicated IT equipment whose power can be assigned to a single customer of the data centre.

This mechanism is further explored in the BCS white paper on data centre energy efficiency metrics[19]. In brief the data centre energy consumption can be broken up into fixed and variable parts, these are then allocated on the basis of fraction of allocated IT power capacity to fraction of fixed energy consumption and fraction of drawn IT power to fraction of variable energy consumption. A 'standard' ratio can be used for operators who are unable to determine their fixed overheads.

There are two sets of choices for this stage, whether IT device power is metered or estimated and whether the 'standard' or a custom determined ratio is used for fixed and variable energy.

[19] Effective data centre energy efficiency metrics, http://www.bcs.org/datacentreenergy

| Allocation option | Advantages | Disadvantages |
|---|---|---|
| **Provisioned power and estimated draw** | Relatively simple and easy to achieve | Lower accuracy |
| **Provisioned power and metered draw** | Greater accuracy.<br>Creates an incentive to enable IT device power management. | Requires the installation of metering equipment |

**7-2 Stage 2 device measurement**

| Allocation option | Advantages | Disadvantages |
|---|---|---|
| **'Standard' Fixed and Variable ratio** | Relatively simple and easy to achieve | Lower accuracy |
| **Facility specific Fixed and Variable allocation** | Greater accuracy. | Requires detailed understanding of the methods and the facility |
| **Facility specific, dynamic Fixed and Variable allocation** | Greater accuracy. | Requires more detailed understanding of the methods and simulation of the facility |

**7-3 Stage 2 allocation of energy to devices**

This stage provides for effective, fair and reasonable allocation of ICT based on dedicated hardware within a data centre and is practical for most data centres within a relatively short time period.

One issue that was raised in discussion was whether an operator should be permitted to allocate the fixed overhead of a facility based on a target occupancy figure. This would deal with the situation of a new data centre which is unattractive to initial customers due to the high fixed overheads of a low occupancy building. The counter argument was made that a new facility should be sufficiently modular to rapidly achieve an acceptable efficiency and that a short time period such as 6 months should be sufficient lead in.

### 7.3.4 Stage 3: Simple service power allocations

This mechanism of service power allocation as a share of the stage 1 or 2 device level allocation is intended to allow the initial allocation of carbon for an ICT service delivered from a data centre. Services are increasingly replacing dedicated hardware and if market pressure to reduce carbon is to develop in the ICT sector the allocation of and ability to compare service carbon are essential.

| Allocation option | Advantages | Disadvantages |
|---|---|---|
| **User count** | Works well for commoditised services with identified users such as email | Ineffective where there is a significant variance in the system resource each user consumes. |
| **Allocated resource** | Works well in many cases where user count is not an appropriate measure e.g. virtual machines<br>Recognises the fixed overheads of resource allocation. | Requires a comprehensive database of equipment specifications mapped to logical devices. |

**7-4 Stage 3 allocation**

The allocated carbon for the devices used to deliver the service is determined through the stage 1 or 2 process, the resulting carbon is then allocated across the customers of the service based upon the user count as a fraction of total users or the allocated resource as a fraction of the total resource.

### 7.3.5 Stage 4: Real per service allocation

The end goal is to achieve the ability to be able to make a fair and reasonable allocation of the overall energy consumed to deliver an ICT service. This includes allocation of not just the data centre energy but also the share of the compute, network and storage energy consumption associated with the service. At present there are no commonly agreed standards to allow this and most operators do not have the required data available electronically.

The BCS and other bodies such as the OGF are researching methods of performing this allocation.