2018

Basware

SCOPING STUDY INTO THE CARBON IMPACT OF ELECTRONIC INVOICING

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1 Introduction

1.1 Tasks & deliverables

The following tasks were agreed at the start of this project. We would:

- Undertake a literature review of industry, competitor and scientific evidence comparing the environmental impact of paper and electronic services.
- Review current environmental policies and data collected / reported by Basware
- Provide recommendations on communicating Basware's carbon impact – and whether a more detailed Basware-specific analysis would be beneficial

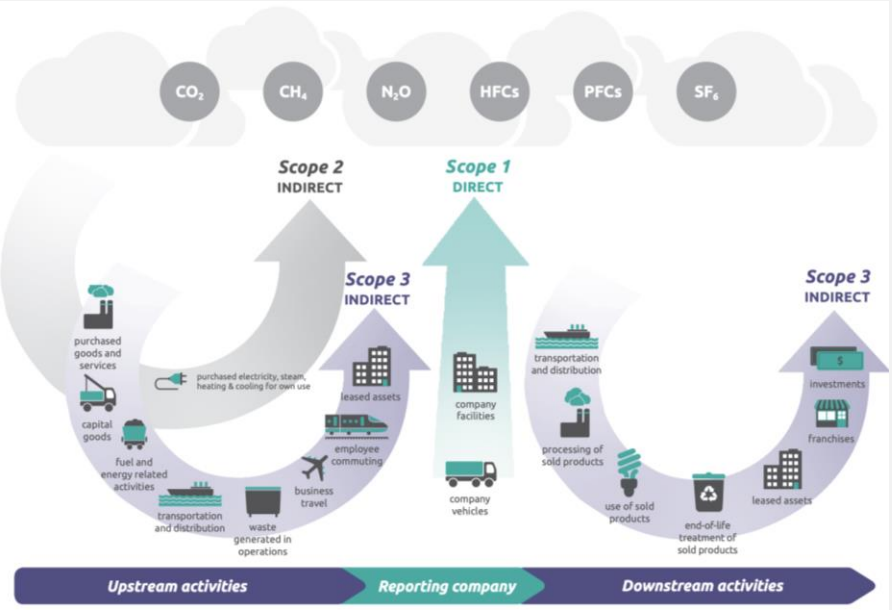
The key deliverable was:

- A briefing note summarising the key findings of the above research (this document). This would be delivered in a simply-formatted Word document that can be used as source of content for internally/externally facing web pages, PowerPoints, documents.
- The document would include a quantitative figure for the impact of Basware document service based on existing and publicly available data. This will include any caveats/assumptions and a narrative on the confidence you can have in the figure

Introduction to carbon footprinting terminology

For those readers who are new to greenhouse gas accounting we have provided a description of some of the basic terms and concepts used in this document.

- **Carbon footprinting and life cycle assessment (LCA).** These are well established methodologies for calculating the *total* carbon impact of the 'life cycle' of a product or service (including upstream suppliers and the downstream use of Basware products). Many reports using the terms 'greenhouse gas (GHG) emissions', 'carbon footprint' and 'carbon emissions' interchangeably. Technically it is most accurate to use the term 'greenhouse gas emissions' as these cover non carbon dioxide gases such as methane.
- **Carbon dioxide equivalent (CO_2e).** Many gases contribute to global warming – the most well-known is carbon dioxide (CO_2). Not all gases have the same 'global warming potential' (GWP) – for example, one kg of methane gas causes 28 times as much warming as a kg of carbon dioxide. The 'CO_2 equivalent' (CO_2e) metric is a way of expressing the total global warming potential of a process where multiple greenhouse gases are emitted.
- **Emissions 'Scopes'.** In corporate GHG disclosures you will often come across emissions described as being in Scope 1, 2 or 3. This refers to terminology used in the Greenhouse Gas Protocol Corporate Standard[1]. Scope 1 includes all emissions that result *directly* from the operations of a business (e.g. gas boilers). Scope 2 covers purchased electricity. Scope 3 covers all other sources of indirect emissions – these occur the in the supply chains of businesses and also downstream as a result of the use of a business's products and services (e.g. the downstream Scope 3 emissions of a car manufacturer are the emissions from the use of the car). See the figure below, taken from the GHG Protocol.
- **CDP.** Formally called the 'Carbon Disclosure Project', CDP is an NGO that runs a platform where organisations can disclose climate-related data (such as total emissions, targets, etc.). Data submitted by Basware this platform has been used in this report. This data is used by stakeholders – principally investors – to benchmark companies.



[1] Available at: https://ghgprotocol.org/corporate-standard

2 Electronic vs. paper-based services

This section summarises the findings of a desk-based review of scientific and industry reports on the climate change impacts of switching from paper-based to digital services.

We identified five different studies that have estimated the climate change impacts of changing from paper-based invoicing to e-invoicing (see Table 1 below). These included studies funded by e-invoice providers such as Converga and Opus Capita, as much as a decade ago.

Our key take-aways from the review of these studies is as follows:

- All five studies demonstrated significant carbon reductions resulting from the switch to digital services – these reductions ranged from a 66% to a 99% improvement
- Four of the studies examine climate change impacts only and excluded other environmental issues associated with paper and digital services (e.g. water footprint, acidification, ozone depletion etc.). Kim J. and Rohmer, S. (2012) do examine a broader set of environmental impacts, but conclude 'climate change' as being the most important. This provides a good basis for Basware focusing on climate change
- The five studies all used very different boundaries and assumptions – making it impossible to draw meaningful comparisons between them. For example. three studies have excluded *significant* sources of relevant emissions – for example three failed to account for emissions reductions associated with FTE productivity gains (i.e. reduced office space, computer use, commuting and business travel of accounts payable staff). These were identified by the two studies as being significant. We also find it is significant in our analysis
- Given the complexity and variability of how invoicing systems are designed and used, the actual changes in emissions are sensitive to a few key variables. Studies mention the following: the carbon intensity of electricity supplies (this is influenced by locations of users and servers); and average user commuting modes and distances.
- Forestry and pulp production are identified as the major source of emissions for paper-based systems. Interestingly, there is no mention in the studies of the significant CO_2 emissions from unsustainable harvesting of timber for pulp & paper. This would likely make the carbon benefit of a switch to digital much better and is also an issue at the very top of environmental NGO and corporate sustainability priorities
- The rapid pace of IT equipment innovation was noted by authors – in particular the increasing energy efficiency of cloud computing. The analyses undertaken in 2008 will be now very out-of-date from a technical point-of-view. A similar case can be made for electricity grid decarbonisation, which has accelerated rapidly in some regions

During our review we also identified that in 2009 the European Commission Expert Group on e-invoicing[2] noted carbon and environmental benefits as a reason for promoting the uptake of this approach – although it doesn't reference any specific research or data to back up this claim.

[2] Expert group on E-invoicing (2009) Final report of the Expert Group on E-Invoicing. DG Internal Markets.

Table 1: Studies comparing electronic and paper-based payment services

Services analyzed	Researcher / business	Year	GHG change from switch	Key conclusions & comments
Consumer electronic billing and payment system vs. paper equivalent	University of Technology of Troyes, France [3]	2012	- 99%	• Global warming is most significant environmental impact • Electronic billing had significantly lower impact across all impacts
Comparison of paper-based and paperless accounts payable systems	Consultancy analysis for Australian payments provider Converga[4]	2008	- 95% to -99%	• The reduction in staff numbers for handling paper invoices - and their associated commuting emissions - identified as major carbon saving area for digital services. • The main source of carbon emissions for e-invoicing is client computer usage. Converga's payment system used on premises servers and the impact of these were negligible
Effects of a total change from paper invoicing to electronic invoicing in Sweden.	Research funded by Itella Information AB (now Opus Capita)[5]	2008	- 85%	• Study focused on energy use and climate change impacts • The main greenhouse gas emissions of the electronic invoice system arose from energy use of the servers where the electronic invoices were converted, stored and accessed • The electricity mix was of great importance for the resulting greenhouse gas emissions • Benefits significantly reduced if electronic invoices printed by users. • However this study did not consider staff commuting and travel emissions for unknown reasons
Assessing the Carbon Footprint of Paper vs. Electronic Invoicing	Conference paper by researchers from University School of Economics, Finland [6]	2010	- 63%	• Case study analysis of a Finnish company that switches to digital invoicing • Most carbon reduction from automation of processes i.e. reduction in staff needed to process documents (i.e. less office space, business and commuting travel)
Comparative LCA of a digital invoice versus a paper invoice	Consultancy analysis for POCHECO, a French envelope manufacturer[7]	2010	+77% to -77%	• Overall conclusion is that electronic is better from carbon perspective – an interesting conclusion for an envelope manufacturer! One of their scenarios did show paper was better, however this was where electronic users systematically printed documents using single-sided printing • The analysis did not examine staff commuting impacts and assumed no computers were used in paper based invoicing systems. Something we think is unrealistic

[3] Kim J. and Rohmer, S. (2012) Environmental Life Cycle Assessment on Paper and Electronic Billing & Payment System. A paper to be presented at the International Conference on Organizations, institutions and innovation in the ICT sector: Where do we stand?
[4] Hatch Associates Pty Ltd (2008) Digital invoicing & the environment - A Comparative Life Cycle Assessment. Analysis for Converga
[5] Moberg, A. et al (2008) Effects of a total change from paper invoicing to electronic invoicing in Sweden.
[6] Tenhunen, Maija and Penttinen, Esko, (2010). Assessing the Carbon Footprint of Paper vs. Electronic Invoicing. ACIS 2010 Proceedings. 95.
[7] Le Pochat et al (2010) Comparative LCA of a digital invoice versus a paper invoice

3 Basware service carbon impacts

3.1 Currently reported emissions

Basware publicly discloses the quantity of greenhouse emissions that result from office energy use (electricity and fuels) and staff business travel (flights). The results for 2017 are shown in Table 2 below. Some 70% of electricity-related emissions result from the operations of two offices (Iasi in Romania and Chandigarh in India). These locations account for about half the electricity used by Basware but are located in regions with high carbon electricity grids (i.e. grids using coal and gas and few renewable or nuclear sources of energy).

Table 2: Basware emissions for 2017[8] reported to CDP

Emissions source	**Emissions scope**	**Emissions (tCO_2e), 2017**
Fuels e.g. diesel, petrol	1	353.95
Electricity use	2	1,036.79
Business travel (air)	3	1,906.91
Total		**3,297.65**

3.2 Comparing Basware with paper systems

In this section we use data from Basware and estimates of other value chain emissions to draw comparisons with the impact of paper-based invoicing systems published elsewhere.

From the studies reviewed in the previous section, it was decided that three additional sources of Scope 3 emissions had the potential to be significant when considering the total carbon footprint of delivering Basware services, and so were estimated for this analysis:

- Upstream: The production and operation of outsourced servers (e.g. Amazon AWS)
- Downstream: Basware customer office energy use (in particular computing)
- Downstream: Basware customer travel (admin staff commuting)

We have used assumptions on productivity gains quoted in the Forrester TEI report and figures previously reported by other e-invoicing studies to develop a first order estimate of Basware's total carbon footprint – and that of a comparable paper-based system. The key assumptions, data sources and results are set out in Table 3 and Table 4 below.

[8] From spreadsheet 'Emissions_calculations' provided by Elisabeth Leino, Basware

Table 3: Key assumptions and data sources for estimating Basware's total carbon footprint

Category of emissions[9]	Emissions source	$kgCO_2e$/ invoice	Data source & calculation
Scope 3, upstream: Purchased foods & services	Amazon Web Server energy use and manufacture	0.002	Based on worst case scenario reported in analysis undertaken for Opus Capita study[10] that analysed total invoicing in Sweden in 2008. The study reported server usage emissions of 5,400 tCO2 delivering a total of 1.4bn invoices. Their server footprint was calculated using assumptions on the number and power requirements of server units. As noted in earlier sections, server efficiencies will have increased significantly compared to the technologies used when this study was undertaken.
Scope 3, upstream: Business travel	Basware staff air travel	0.016	Greenhouse gas data from 2017 Basware CDP report. Calculation assumes Basware handles 122 million documents per year (data provided by Elisabeth Leino, Basware). Other forms of business travel were excluded (e.g. cars and trains) as these were not reported in CDP. These warrant investigation in the future if the study is done in more detail
Scope 2	Electricity used in Basware offices	0.008	See sources and assumptions in 'Business travel'. We have not accounted for the benefits of buying renewable electricity – this is something to explore in the future and could eventually reduce this source of emissions to zero.
Scope 1	Fuel used by Basware offices & equipment	0.003	See sources and assumptions in 'Business travel'
Scope 3, downstream: Use of sold products & services	Energy used in offices of Basware customers	0.022	Calculated based on the following assumptions: Desktop computer and screen draws 400W. It is used 220 days per year, 8 hours per day. We assume 10,185 invoices processed per FTE per year (based on Forrester TEI report). Carbon footprint of electricity use calculated global average electricity carbon intensity figure from International Energy Agency.
Scope 3, downstream: Use of sold products & services	Basware customer accounts payable staff commuting	0.078	Average commuting impact per FTE is 0.8 tCO2e/ year – this is based on figure reported for New York city workers, which we think represents a typical mix of public and private transport modes for a large services-based city[11]. Per invoice impacts calculated assuming 100,000 invoices are processed in a year by 9.8 FTE staff in accounts payable (assumptions from Basware Forrester TEI report).
TOTAL		0.13	

[9] Categories are based on those used the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

[10] Moberg, A. et al (2008) Effects of a total change from paper invoicing to electronic invoicing in Sweden.

[11] Transalt (2008) Rolling Carbon: Greenhouse Gas Emissions from Commuting in New York City

Table 4: Key assumptions and data sources for estimating paper invoice total carbon footprint

Category of emissions[12]	Emissions source	$kgCO_2e$/ invoice	Data source & calculation
Scope 3, upstream: Purchased foods & services	Paper invoice production	0.017	Opus Capita life cycle assessment study[13]
Scope 3, upstream: Purchased foods & services	Paper envelope production	0.004	Opus Capita life cycle assessment study[13]
Scope 3, upstream	Accounts payable staff commuting	0.127	Average commuting impact per FTE is 0.8 tCO2e/ year – this is based on figure reported for New York city workers, which we think represents a typical mix of public and private transport modes for a large services-based city[14]. Per invoice impacts calculated assuming 100,000 invoices are processed in a year by 16 full-time equivalent staff in accounts payable (assumptions used in Basware Forrester TEI report).
Scope 2	Invoice printing by accounts payable	0.012	Opus Capita life cycle assessment study[13]
Scope 2	Accounts payable staff computer use	0.037	We assume that, even in paper-based systems, accounts payable staff still use computers to record and then analyse and report on customer payments. We assume a desktop computer and screen draws 400W. It is used 220 days per year, 8 hours per day. We assume 6,250 invoices processed per FTE per year (based on Forrester TEI report). Impact of electricity use calculated global average electricity carbon intensity figure from International Energy Agency.
Scope 3, downstream: transport and distribution	Invoice posting	0.009	Opus Capita life cycle assessment study[13]
TOTAL		0.205	

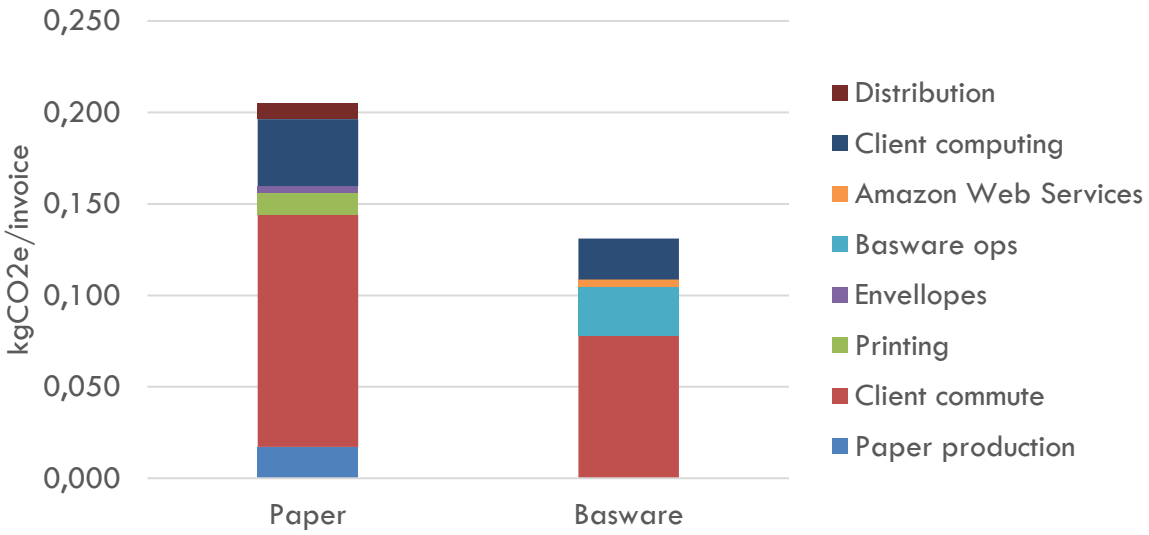
[12] Categories are based on those used the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

[13] Moberg, A. et al (2008) Effects of a total change from paper invoicing to electronic invoicing in Sweden.

[14] Transalt (2008) Rolling Carbon: Greenhouse Gas Emissions from Commuting in New York City

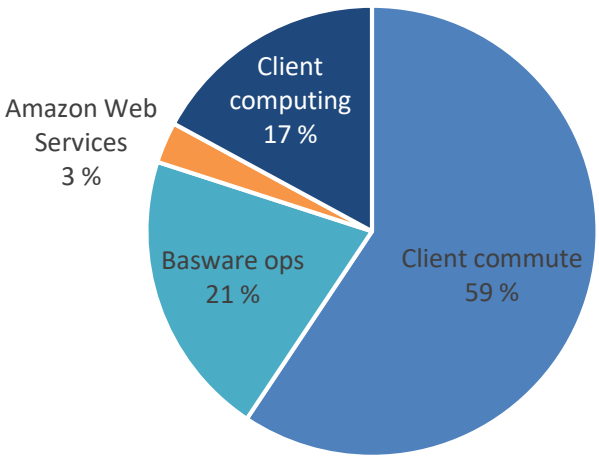
Using the assumptions set out in the tables above, we have calculated a 36% reduction in emissions from a switch from paper-based to digital invoicing. The reduction is primarily driven by a reduction in the number of FTE accounts payable staff needed to administer a digital system. We assume computer energy use also falls – as it is assumed that even in paper-based systems, accounts payable staff need to record invoice information into computer systems. Additional savings in these emissions sources could be possible if Basware systems enable more home-working by staff, however we have not included this within our basic model.

Figure 1: Comparison of Basware and paper-based invoicing



Basware contributes 21% of the total carbon footprint (see Figure 2 below). This highlights the importance of company efforts to reduce the need to travel by air and also pursuing commitments to purchase renewable electricity (particularly for those offices based in regions with fossil-fuel dependent electricity grids – such as India and Romania). We estimate that Amazon Web Services only contributes 3% of the total footprint – although this would benefit from review in the future to check these estimates are robust (or at least conservative). An overview of the high-profile environmental impacts of cloud computing are summarised in Box 1 on the next page.

Figure 2: Contribution of emissions sources to Basware total carbon footprint



Box 1: Dirty Cloud? Counting the carbon cost of IT infrastructure

Globally, data storage and data networks make up c. 2% of global energy demand – almost 400 terawatt hours per year[15] (more than all the electricity used by the United Kingdom in the same period). Data centres make up about half of this energy demand. The majority of these units are currently located in the United States – but an increasing proportion will be located in Asia in the future. Improved server equipment and infrastructure efficiencies have actually meant that total energy use by data centres has seen limited growth since 2010, despite rapid increases in demand for their services[15]. This modest growth in energy demand is expected to continue in the short term (to 2020) – despite a predicted growth in storage drives of 46%. This is due to improved equipment and infrastructure efficiencies and the expansion in extremely efficient 'hyperscale' data centres (such as those from built by Amazon).

Consumer and NGO interest in the environmental policies of tech giants such as Microsoft, Google and Amazon has also risen in recent years. In response, technology companies have stepped up their environmental commitments – particularly on renewable energy procurement. Indeed, in the United States, ICT companies have been responsible for more than half of the total corporate renewable energy Power Purchase Agreements since 2015[15].

The most well-known assessment of technology company environmental policies is Greenpeace's 'Clicking Green' scorecard (available at http://www.clickclean.org/). The NGO graded Amazon as a C overall, with competitors Google and Microsoft scoring A and B respectively – see Figure 3 below. Although Amazon's advocacy activity in the past year was welcomed it scored very poorly on transparency (F) and renewable energy policies (D). Greenpeace spoke to a number of major Amazon AWS customers who, like Basware, remain unable to get data on the carbon impact of AWS that they can use for reporting and measuring their own total carbon footprint. The report also criticizes AWS's lack of transparency on its claim of having 'carbon neutral regions'. It is unclear what this means and if it is credible.

This lack of data and the 'carbon neutral regions' were mentioned by Basware in its latest CDP report: "*We have been unable to calculate emissions from purchased goods and services due to gaps in data. The main source of emissions from purchased goods and services is from Basware's data center partners Amazon Web Services (AWS) and Rackspace. 95% of Basware's usage of AWS is located in carbon neutral regions (EU-Ireland and US-Oregon). AWS has a long-term commitment to achieve 100% renewable energy usage globally*."

Figure 3: Greenpeace 2017 'Clicking Green' scorecard of leading cloud service providers

	Final Grade	Clean Energy Index	Natural Gas	Coal	Nuclear	Energy Transparency	Renewable Energy Commitment & Siting Policy	Energy Efficiency & Mitigation	Renewable Procurement	Advocacy
amazon.com web services	C	17%	24%	30%	26%	F	D	C	C	B
Google	A	56%	14%	15%	10%	B	A	A	A	A
Microsoft	B	32%	23%	31%	10%	B	B	C	B	B

[15] OECD/IEA (2017) Digitalization & Energy. Data for 2014 and 2015.

4 Key findings & recommendations

Electronic vs. paper-based services: the case for digital is already clear

- Climate change is identified as a priority environmental issue for the sector, and so there is a good case for considering 'climate change' as a material environmental issue for Basware
- All published analyses of electronic invoicing show significant carbon reductions from switching to electronic from paper systems (63% to 99% reduction)
- We constructed a basic model to compare the carbon footprint of Basware services and paper-based systems. We estimated a reduction in emissions of 36%
- Emissions savings compared to paper-based systems appear to be mainly from client-side staff productivity gains i.e. the reduction of accounts payable FTEs and associated activities (commuting, computer use, etc.).
- These findings highlight the practices of Basware's *customers* will significantly affect the overall carbon efficiency of the service, in particular: the scale of staff productivity gains; the carbon intensity of customer electricity supply; the efficiency of client computers; and whether customers still print documents. Basware could seek to influence all these issues as part of client-engagement processes and how the platform is deployed
- Timber and pulp products are 'high deforestation risk' commodities. Avoiding the use of illegally harvested wood products has become a major corporate sustainability requirement (including at Basware customers). This should be communicated as part of any environmental case for switching to digital services

The carbon impact of the Cloud is small, but under scrutiny

- This lack of transparency by Amazon – and the sector more broadly – made estimating the Cloud carbon footprint very difficult. Based on previous competitor studies we estimate the contribution of this source of emissions is relatively small (although this is very uncertain)
- Despite the relative insignificance, it is an obvious aspect of Basware's overall service and is under increasing scrutiny. Our review identified a growing interest from NGOs on the energy use associated with ICT – and servers in particular.
- For example, Amazon scores relatively poorly in the Greenpeace scorecard: well behind competitors Google and Microsoft. Amazon scored particularly poorly on transparency
- Amazon AWS has recently increased its public advocacy for renewables and has a commitment to source 100% renewable electricity. However, the nature of its renewable energy procurement and its rapid server expansion in regions dependent on coal-fired power (e.g. Northern Virginia, US) have left campaigners questioning the business's actions

More detailed analysis needed, if public claims are to be made

- If Basware wishes to put this sort of analysis in the public domain we strongly recommend doing a more in-depth analysis. This project was only intended to review existing analyses and provide first-order estimates of benefits. It would be normal practice to do a much more comprehensive carbon analysis for making credible external claims – much like Basware has done with the 'Total Economic Impact' report on the financial case for change
- Basware contributes 21% of the total carbon footprint. This highlights the importance of company efforts to reduce the need to travel by air and also accelerating commitments to purchase renewable electricity (particularly for those offices based in regions with fossil-fuel dependent electricity grids – such as India and Romania)
- If possible, Basware should seek to clarify with Amazon the status of the servers where Basware's software is hosted: are these carbon neutral and if so what does this mean? It is appreciated that Basware has limited influence over Amazon, however it is worth being a vocal on this issue and trying to advocate for more transparency