NB: Since the publication of this document the Carbon Trust has produced a substantive analysis on the impacts of streaming. (see links at end)

techUK

Is your online habit killing the planet?

Channel 4 Dispatches doesn't let the truth get in the way of a good story

November 2020

Channel 4 recently broadcast a 30 minute *Dispatches* programme: *Is your online habit killing the planet?* This explored the physical infrastructure – communications networks and data centres - that enable us to access video content on demand and emphasised that our internet habits are profligate and are driving colossal, unseen growth in electricity demand and fossil fuel consumption.

We agree that digital infrastructure has an energy impact that many consumers are unaware of and that current business models, where most content can be consumed for free, do not provide any meaningful signal about these energy impacts to the user. But this is not new – we have said this ourselves[1] on many occasions. More transparency is needed but attributing carbon to a cloud service at point of use is complex and will take time. And data centre energy use in the UK is not hidden: we publish sector electricity consumption[2] [3]and are open about energy stewardship, renewables procurement, targets, commitments and indeed the challenges we face.

Meanwhile, we have to work hard to improve awareness and help consumers, and indeed businesses and government, become responsible digital citizens, and the programme made some excellent points about the amount of time we spend online (often without realising it), that these activities have an energy impact beyond that of the device, and that this impact varies depending on the type of internet based activity. So far so good.

But then the wheels fell off. Instead of identifying ways to help consumers reduce their energy impact (see our suggestions below) the programme opted for sensationalism, citing figures that even the briefest internet search would have revealed are inflated, outdated or discredited. It is a common occurrence: efficiency improvements are rapid in the sector, quickly outdating even relatively recent research. Here we will address some of the more misleading impressions and erroneous or unsubstantiated claims made by the programme.

"There are eight million data centres – and this is just a small one." Let's be clear, there are not 8 million data centres. Yes, there are thousands of data centres, and hundreds of very large data centres, albeit not as large as the one being constructed in China. But millions, no. There are millions of servers in cupboards and cubby holes in offices, but these are not data centres. In the UK, a highly digital economy, there are between 400 and 450 recognisable data centre facilities.

"Data centres do nothing except store photos and videos." The impression given is that data centres and the cloud services they support are entirely consumer facing and do little other than provide photo storage and video on demand services. In fact, data centres underpin every aspect of our modern economy, from bioinformatics to supermarket logistics. Most pertinently to this discussion, data centres enable digitalisation and by doing so, carbon and energy savings vastly in excess of their own footprint. The International Energy Agency's report *Digitalisation and Energy* explains this[4] as does our publication, *Ten Myths About Data Centres*[5].

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[1] See Lost In Migration: Attributing Carbon to Data Centre and Cloud Services

[2] UK Data Centre Sector Energy Routemap

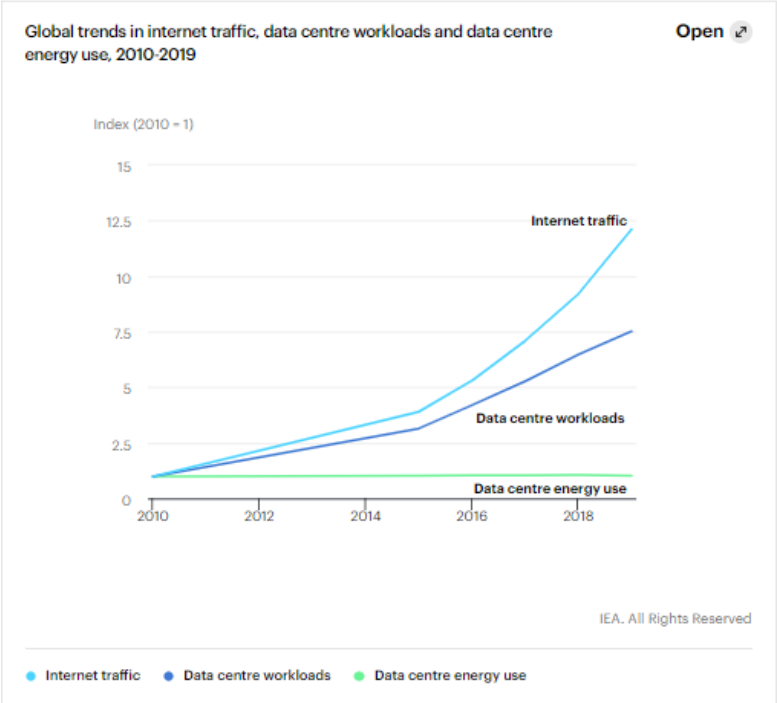
[3] This data is reported through the Climate Change Agreement and subject to third party audit

[4] EIA, Digitalisation and Energy: https://www.iea.org/reports/digitalisation-and-energy

[5] techUK: Ten Myths About Data Centres

"Data centre energy consumption is spiralling out of control."

Data centre energy consumption is growing, but incrementally, not exponentially. External bodies like the International Energy Agency report data centre energy as remarkably flat[6]. This may seem counterintuitive as we see lots of large new data centres being constructed, each of which will have a significant electricity demand. But at the same time, traditional (and highly inefficient) on-premises IT is being moved to cloud and outsourced to these data centres. This act alone reduces energy consumption by at least two thirds and in some cases by over 90%. However, these facilities are also meeting increasing demand for existing services and new types of demand altogether, and data volumes are growing so fast that it is a constant battle to keep up.



Source: IEA, *Global trends in internet traffic, data centre workloads and data centre energy use, 2010-2019*, IEA, Paris https://www.iea.org/data-and-statistics/charts/global-trends-in-internet-traffic-data-centre-workloads-and-data-centre-energy-use-2010-2019

"The ICT sector uses the same energy as the airline industry." This old chestnut dates from 2007 when Gartner wanted to make the point that ICT was a significant energy consumer. However, there were issues with the figures then and also with the methodology. It does not account for the fact that airlines emit scope 1 and ICT scope 2, or that ICT is a much larger sector, so it is a bit like saying an elephant and a goat produce the same amount of manure and that therefore we need to do something about the elephant. Moreover, the ICT sector's footprint includes the manufacturing of digital devices and the electricity used to power communication networks and data centres. The figure for the aerospace sector covers only in-use emissions. No account is given for the sector's ability to deliver emissions reductions elsewhere or that ICT has an agreed emissions reduction pathway and is decarbonising rapidly through renewable energy procurement – a much harder call for airlines. It also ignores radiative forcing which increases the impact of emissions from airlines.

The dramatic increase in the use of zoom due to COVID-19 (from 600,000 to 13 million users in the UK) led to a huge surge in energy consumption.

In reality, the opposite happened. Online collaboration platforms like Zoom enabled organisations to make the transition from office to remote working quickly and easily. Carbon emissions, and electricity consumption, dropped significantly across the economy as travel was restricted, organisations shut down and operations moved online. As a result, data traffic across ICT networks increased[7][8]. Fixed networks (broadband and Wi-Fi) recorded the largest increases, ranging from a 20% to 100% increase. The biggest increase was seen in voice over wi-fi services. In terms of data traffic, BT saw a 100% increase in daytime traffic across its fixed broadband network but reported no

[6] https://www.iea.org/reports/data-centres-and-data-transmission-networks
[7] Ericsson (Blogpost 14 April 2020), How networks are adapting to the new normal. www.ericsson.com/en/blog/2020/4/networksadapting-data-traffic-new-normal
[8] Internet Traffic and the Corona Virus: Guest blog by Kurtis Lindqvist

noticeable increase in electricity use or carbon emissions. Similar patterns were recorded elsewhere[9]. We agree that it's not just about the networks though: online platforms like Zoom do need data centre capacity, but figures aren't yet available and won't be until next year. Incidentally, we've also struggled to find data published by Channel 4 on the carbon impact of their streamed offerings, so we will look forward to seeing this too.

"A one hour zoom call consumes 1KWh and is the equivalent of driving 2km by car and 10km by train …so if it is a 3-4 hour meeting it is probably better to go there".

This is one of the more damaging and irresponsible claims in the programme because it could mislead people into making more carbon intensive choices. So 1KWh does roughly relate to 2km driven by a new car, using conversion factors supplied by DUKES[10]. And we agree that the carbon equivalent of a zoom call depends on multiple factors, but even so, there is a wide gulf between our sources and the programme's. For instance, Mike Berners-Lee, a well-respected researcher, has calculated that a zoom call represents from 2g CO_2e to 50g CO_2e per hour depending on device type (plus a share of the embedded energy of the device, which would also be applicable to a car or train)[11]. Converting back, the energy consumption stated in the programme is exaggerated from 5-fold to over 100-fold. The main thing to remember is that it is almost certainly NOT better to travel to a meeting than to Zoom unless you can walk or cycle, or are a pigeon.

"Streaming Despacito uses 900TWh; the annual energy consumption of five African countries"

There are three things wrong with this:

- Firstly the programme fails to differentiate energy and electricity: they are not the same and the electricity consumption of a country is usually a small fraction of its energy consumption[12].

- Secondly the calculations published to support this only attribute 8GWh- less than 1% - to data centre energy use, yet the programme gives the impression that this is a data centre energy consumption issue.

- Thirdly, the assumptions and modelling are incorrect, like a previous claim about Gangnam Style and the energy of Burundi which exaggerated consumption by around an order of magnitude and was soon debunked by the Carbon Trust. Have a look at this FactCheck by the Carbon Brief[13], which spells out why the Despacito example is so wrong. Mistakes are not limited to assumptions – the Shift Project for instance made a bit/byte conversion error which inflated their figures eightfold. They were later corrected – see below.

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[9] The Nordics operator Telia, with operations in Sweden, Finland, Norway, Denmark, Estonia, Latvia and Lithuania reported an electricity consumption increase of less than 1% across its mobile network, despite a 20% mobile data increase, and electricity use was unchanged across at its fixed and core network operations. www.gsma.com/newsroom/press-release/covid-19-network-traffic-surge-isnt-impacting-environment-confirm-telecom-operators/

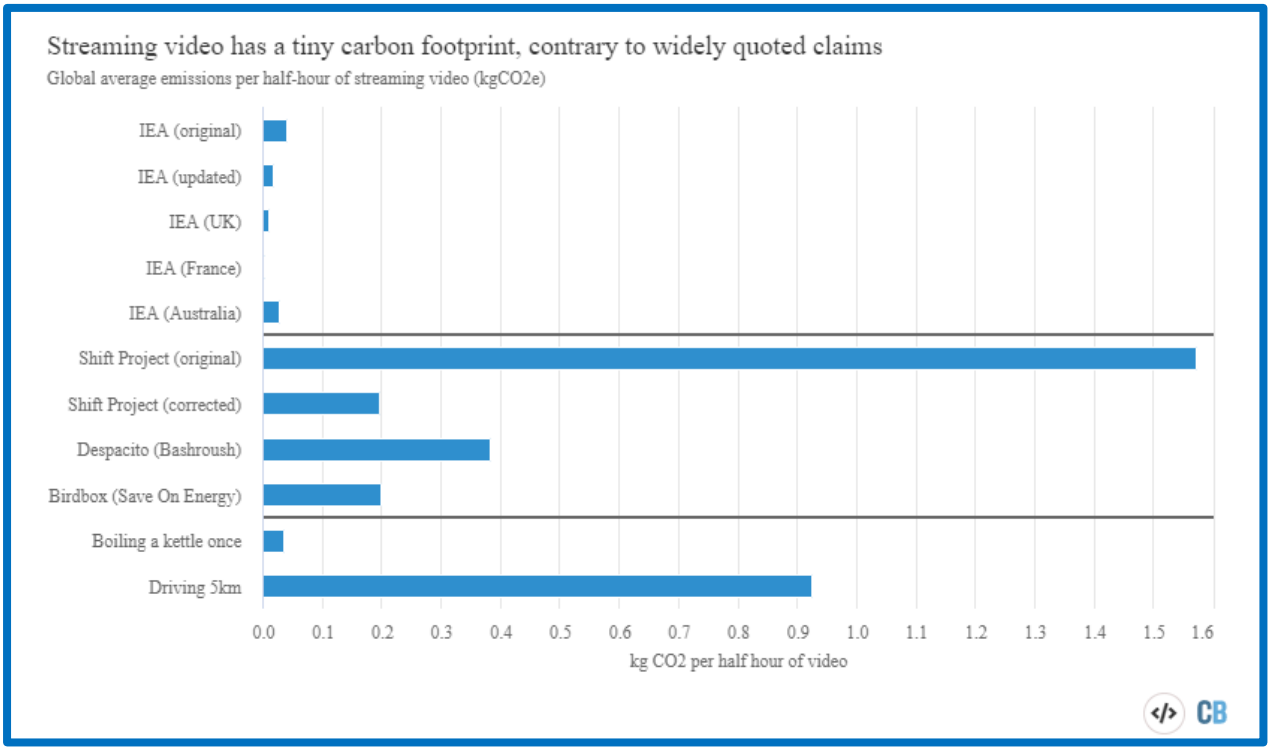
[10] Digest of UK Energy Statistics, a fantastic source of energy data

[11] "How Bad are Bananas?" pp25-26, Mike Berners-Lee

[12] Energy comes in many forms and in most countries only a minority of the energy consumed is used to generate electricity; the majority is used as fuel or for other forms of direct combustion. In the UK for instance only 17% of energy consumption is attributable to electricity (DUKES 2020 p 75) It is therefore very important to use the correct terms.

[13] See: https://www.carbonbrief.org/factcheck-what-is-the-carbon-footprint-of-streaming-video-on-netflix?utm_content=buffer6142d&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

Image extracted from the Carbon Brief Factcheck, November 2020, comparing claims



In conclusion, the IEA calculate that the claim made by the programme exaggerates the energy consumption of streaming 22-fold. This includes the fact that they underestimated device energy use while overestimating data centre and network consumption. Other commentators, such as Ericsson, have debunked earlier claims. The brief also included two important observations – that carbon impacts are largely dependent on grid energy mix and that the complexity of direct and indirect impacts, together with rebound factors, make the real impacts very difficult to calculate.

"Growth of data results in a parallel growth in data centre energy consumption." Wrong. Data is not cheese. If we needed twice as much cheese, then we would need twice as many dairy cows (or drink a lot less milk). Due to a combination of technology advancements such as Moore's law and virtualisation, the energy needed to process a given amount of data has decreased by around seven orders of magnitude in just over three decades. If applied to the airline industry a 747-400 would be able to fly to New York and back on 16.5ml of fuel, the equivalent of just over three teaspoons of Calpol. While this is obviously not a realistic expectation it at least shows the scale of the achievement, and why the sector can continue to meet an explosion in demand for digital data with only an incremental increase in energy. There are multiple evidence-based, peer-reviewed studies to back this up[14].

"Data centres are buying dirty power." When we last checked[15], 76.5% of the electricity purchased by UK commercial data centre operators is 100% certified renewable, and a further 10% is purchased according to customer requirement which increasingly means renewable, taking that total up above

[14] See Lawrence Berkeley: https://science.sciencemag.org/content/367/6481/984 and more lately from the International Energy Agency: https://www.iea.org/fuels-and-technologies/data-centres-networks

[15] These figures are from 2016 but we are currently polling the sector again and we anticipate this figure to be much closer to 100% by the end of 2020.

85%. Google is the world's largest purchaser of renewable power, meeting its requirements through power purchase agreements; direct contracts with renewable generators that create additional utility scale renewable capacity. Operators are increasingly adopting this form of power procurement. This is spelt out in more detail in our sector energy routemap.

"Data centre power consumption is a dirty secret." It is not. In fact, consolidating IT activity into purpose-built facilities improves both transparency and efficiency. The dirty secret, if there is one, is what is not in data centres, servers left on premises under the radar. Enterprise operators report corporate energy and carbon through mandatory and voluntary regimes. The UK commercial sector monitors and reports its energy consumption at sector level. Commercial operators here currently consume around 3TWh of power a year, just under 1% of electricity production. Energy consumption is measured, audited and publicly reported at regular intervals in our CCA reports[16]:

In conclusion…

All this is old, old, old. People have been making stuff up about data centre energy use for decades. Back in 2013 the New York Times ran an article about the negative impact of data centres and we rebutted that point by point in a similar way in Data Centres and Power: fact or fiction. Most recently, in March the BBC streamed an inaccurate piece which, by a remarkable coincidence, covered almost identical ground to this Dispatches programme.

It is disappointing that while the industry has made huge strides, journalism has not. The sensationalist claims, the derivative story pretending to be new, the "black box" calculations by unnamed "experts", and the lack of fact checking meant that a number of obvious errors undermined what would otherwise be a worthwhile attempt to help us understand the energy impact of our online behaviour and how we can best mitigate it.

Our biggest concern is that by promulgating misinformation, the programme does everyone a disservice. Firstly, exaggerated claims can drive the wrong behaviour by those trying hard to do the right thing. Secondly, dramatic assertions without any supporting evidence, caveats or assumptions, add confusion to a debate that desperately needs more clarity; this programme squandered an important opportunity to improve understanding. Finally, this distracts us from the real climate emergency that we are facing where the intelligent use of digital technology will be critical if we are to achieve our ambitious net zero targets.

[16] CCA reports 1 and 2 (See links at end)

So what can we all do to help?

And finally, a few tips on things we can all do to reduce the energy impact of our online activities. Rather than watching a streamed programme about the evils of streaming, why not try some of the actions below to mitigate your impact?

- Use smaller devices and screens - they use less power than large ones. The size and power consumption characteristics of end user devices are by far the biggest factor that we can influence as consumers in determining the carbon impact of streaming.
- Using wi-fi instead of mobile to stream, audio-only settings, minimising video and streaming at lower resolution all help but to a lesser extent.
- Don't upgrade your devices all the time – embodied energy is relatively high in digital devices.
- Make sure you recycle ICT equipment correctly – it is classified as WEEE and cannot be thrown in the dustbin. This is not a choice; it is a legal requirement. If it can't be repaired or reused, bag it up and find your local recycling point here www.recycleyourelectricals.org
- Don't leave electronic equipment running when you are not using it, especially streaming services.
- Charge the batteries and connect your IT devices with electricity from renewable sources
- Don't buy more devices than you need.
- Pass on devices you no longer need. There are plenty of resale and charity options.
- If you have a business, move from on-premises or enterprise servers to cloud service solutions.
- Show your suppliers that their footprint matters to you – look at their credentials.
- Buy your digital devices and services from companies that have committed to Science Based Targets.
- Use ICT services that help to reduce carbon emissions; work remotely if you can.

What could Channel 4 do to help?

Demand for video streaming is growing rapidly and threatens to outpace the efficiency improvements that can be made by supporting infrastructure and devices. While the programme made the important point that we are often unaware of the hidden energy impact of our online activities, it could have done more. This 30 minute Channel 4 programme could have been the perfect subject for…er… an analysis of the best way to watch a 30 minute Channel 4 programme. As we know, it was broadcast and then streamed, available in standard or HD formats and as such would have provided a perfect reference point to compare the way that the energy impact varies between broadcast and streaming, between standard and HD streaming, between receiving devices and that this all depends on where you live in the world. That really would tell us something useful and help us all understand how we can become responsible digital citizens. Maybe, this, together with more information on the energy and carbon impact of C4's own internet offerings, could form the basis of a future Dispatches programme.

Useful Sources:

ADDITIONAL NOTE: A Carbon Trust report on the Carbon Impact of Video Streaming has since been published: https://www.carbontrust.com/resources/carbon-impact-of-video-streaming (This study demonstrated that the energy mix of the country in which the activity takes please, and the size and power consumption of the end user device have the greatest overall impact on the carbon impact of streaming).

IEA report: Digitalisation and Energy which explains the trade off between ICT and broader energy savings: https://www.iea.org/reports/digitalisation-and-energy

Carbon brief on impact of video streaming: https://www.carbonbrief.org/factcheck-what-is-the-carbon-footprint-of-streaming-video-on-netflix

IEA report on data centre and network energy: https://www.iea.org/fuels-and-technologies/data-centres-networks

techUK publications

Ten Myths about data centres

Data Centre Energy Routemap

Lost in Migration: Attributing Carbon to Cloud

CCA reports: (First Findings, Target 1 and Target 2)

Data Centres and Power: fact or fiction

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- For more on our data centre programme see: techUK data centre programme: https://www.techuk.org/data-centres-programme/data-centres-resource-index.html

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