Cooling towers, Google data centre, St. Ghislain, Belgium [credit: Google]

Data Centres

and the New Pollution

By Melissa Cogavin, Managing Editor, SCTE

Sending 65 emails is roughly equivalent to driving 1km in a car. In a year, an average person in the developed world adds 136kg of CO2 to their carbon footprint from the emails they send and receive. This is equivalent to an extra 320km driven in a car. Globally, the world's email usage generates as much CO2 as having an extra seven million cars on the roads.
- BBC Science Focus, 2019*

It may surprise you to learn that March 24 was International Data Centres Day, an initiative designed to "raise awareness of the data centre industry and to inspire the next generation of talent," according to Data Centre Frontier. Even the most cursory look at this sector suggests marking out this day is a worthy and vital initiative and actually, it would appear that this is an industry that needs all the marketing it can get.

The average consumer gives little thought to what actually powers all those emails, tweets, Facebook updates and online purchases. Every time you tap your card at the checkout, every ATM visit, every 'crying with laughter' emoji sent, there is a small but incremental cost to the environment. We may be patting ourselves on the back for not using the car, our commutes and foreign holidays on hold; we may think we are reversing the damage done to the planet. All we have actually done is swap one damaging form of carbon emission for another.

While the adoption of new hardware has slowed considerably (iPhones don't change much from one generation to the next these days), the appetite for data has ballooned. Chris Demers, Sustainability Department Manager for Supermicro, a Silicon-valley based provider of green server solutions told Broadband, "The growth in data centres, and growth in data centre energy demand, is projected to be 6-8% annually in coming years, twice the rate of projected economic growth post-Covid."

Some alarming statistics

With this appetite comes an astonishing amount of electricity and water usage. According to the International Energy Agency, (IEA), data networks consumed around 250TWh in 2019, or about 1% of global electricity use, with mobile networks accounting for two-thirds. Elsewhere that estimate is now 3%. Technological advancements are difficult to forecast, but online resource Data Center Knowledge predicts that, "if left unchecked, data centre energy usage could surpass more than 10% of the global electricity supply by 2030." The results of one data centre survey painted a worrying picture of a general scant regard for their own energy output, over-cooling of their premises and a slack approach to energy efficiency.

John Booth is a Data Centre Energy Efficiency & Sustainability Consultant who drilled down into those numbers. "In the UK data centres take up 0.79% of consumption but that is just commercial. That figure doesn't include BT telephone exchanges, hospitals, universities, head offices, government facilities, retail outlets and leisure facilities. It's more like 12%. So, the number we have globally is completely off, it's far, far higher."

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He continued, "The actual impact to the planet is far more significant. We can't get an accurate estimate because nobody is reporting the actual consumption; we are only looking at the top providers, like the prestige car market. All we are seeing is the top 2 %. It is difficult to pin down data as it is constantly evolving and those providing the data do so when it suits them and their shareholders; and that's only the large hyperscale data centres, who have a duty to report their water and electricity usage."

Trying to untangle the reliable sources from the unreliable ones is complex and bewildering. In fact, there is so much noise it is quite difficult to single out any one narrative in order to establish some basic, fairly shocking facts.

As you scroll through your Facebook feed of an evening, this will be actioned through not one, but several huge data centres located all over the world. Estimates vary hugely, but according to one there are currently 450 hyperscale data centres in operation with 150 under construction, but that only accounts for a certain type of data centre. 450 sounds modest enough until we realise this is the tip of the iceberg; this only refers to 'hyperscale' data centres that service your cloud activity. It is more likely that the actual number of data centres worldwide is nearer 8.2 million. Bear in mind also that only 55% of the world's population is currently 'online'.

Data Centres Defined

1. **Enterprise** - owned and operated by the same organisation, eg banks, oil/gas companies, government, schools, universities
2. **Co-location** - professional owner/operators who will seek to attract customers
3. **Edge** - Data centre located beneath a mobile phone tower to save costs for local businesses once 5G has underway. Embryonic; this has yet to be actually deployed anywhere
4. **Hyperscale** - Refers to the style of computing housed in the building and its ability to scale to huge dimensions to cater for the data within. The big tech companies we all know will be running these for themselves using bespoke systems

It is more than a little ironic that an industry catering for data should have such loose figures available about itself. New industries emerge unplanned, chaotically, organically; where technology is evolving at the same rate as commerce there is rarely a road map and often the technology will lap the commerce; once it was fair to say consumers set the pace for technological advancement but now, they are as savvy as those inventing it and the whole sector is trying to keep up with itself.

It is an exciting time, watching an industry grow; you hear the term 'wild west' attributed to this period a lot, suggesting a lack of regulation, standardisation, transparency at best; seat-of-your-pants, bootstrapping, wide-boy antics at worst. Bedroom start-ups become SMEs and graduate into boardrooms; acquisitions, venture capital investment and mergers go on to literally shape the landscape, eventually embedding logos and brand loyalty into our collective subconscious. Usually, a few winners triumph with wealth so staggering that sometimes they even set up foundations to give something back. Or they decide to go hot air ballooning, badly. Or even to the moon.

Most industries emerge out of the other side of this period with a set of clear objectives and the threat of penalties by external forces for not playing by the rules. As such, the data centre industry is still in that wild west period some 20 years in; the data we have to hand about the actual damage these mysterious buildings are doing to our planet is murky and unreliable, aimed at shareholders and the media. There is a reason why the soundbite from BBC Science Focus is out of date. Technology is only part of the problem. At its core are some surprising cultural and commercial tensions and only time it seems will force these issues to change.

Back in my day

One industry insider offered some background; there is a serious cultural divide between those hip, bearded app developers in Silicon Valley sipping oat milk lattés and the considerably older management team running the data centres they are depending on. "The data centre industry is still very young - although it's been around as a term since the 60s with IBM, colocation data centres have only been around since 2000," he told me. "These places are run by 'hairy-arsed, mechanical and electrical engineers' and are time-served apprentices. What they know about PR and soft skills could be written on a postage stamp."

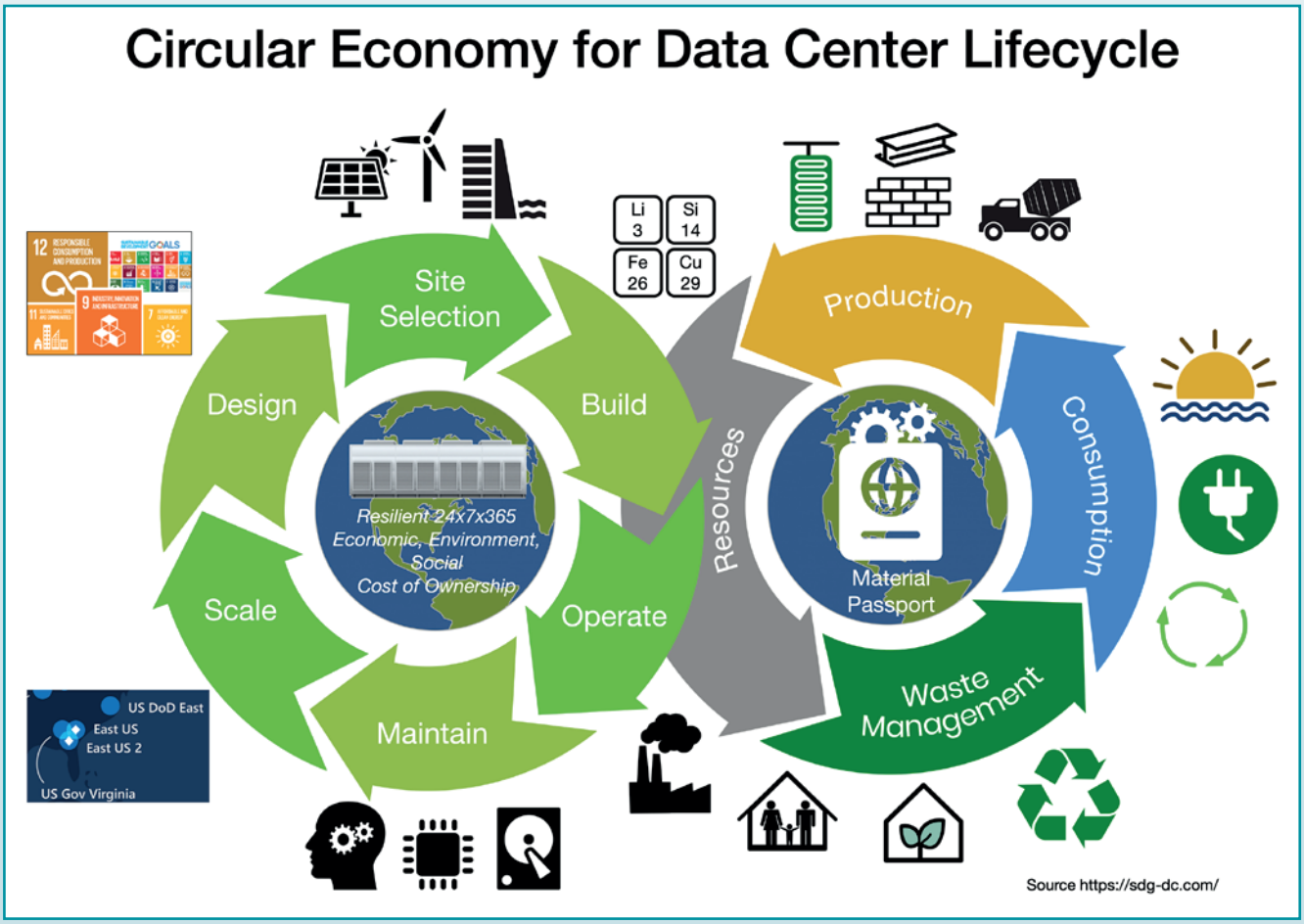
Now in senior management positions, marketing is a foreign language to them, as is their understanding of their clients' needs beyond actual grid capacity. "They communicate very badly."

New tech by definition attracts a young, diverse workforce of millennials, whereas data centres are largely defined as white and male, with an average age of between 53-59. These are people who have been in the industry since their 20s and 30s. There is a significant, problematic generation gap; it is an acknowledged issue within the industry and has been discussed at length.

John Booth went into more detail. "People have fallen into this industry from other places; nobody chooses data centres particularly. It is a complex environment, a data centre. It encompasses IT, telecoms, electrical engineering, air conditioning, mission critical, up-timing resilience. There is no focus on energy efficiency and sustainability. Not many university courses that would give you a good background on all of this. So as a result, there is a strange mix of talent. Another issue is their location; they are often in remote areas away from cities, so staffing data centres is a problem."

He provided a case study in how not to be good neighbours, citing a dispute between a Dutch local council and a data centre with an aggressive planning application. "They put the planning application into the local council, who agreed. Then the larger regional council objected, then the local council objected as a result. Now there is a big legal wrangle, which will rumble on for years; the data centre should have seen this coming and considered their approach, as the potential damage to their reputation will be immense."

He went on, "Now the Dutch farmers union have got 32000 members to appeal the decision to build on prime agricultural land. Be aware there is no direct benefit to build there anyway. The press and the farmers are up in arms, calling the data centre an 'energy consuming, fire-breathing dragon of a data centre'; it's ridiculous. The culture of the data centres, those in senior management positions driving this project lack the soft skills needed to get it over the line. It's a reactive, not a proactive industry." This is completely at odds with the needs of those proactive app developers they are catering to, and will do little to charm those farmers either.



Infographic showing a life cycle of a sustainable data centre [credit: Susanna Kass]

Google data centre, St. Ghislain, Belgium [credit: Google]

That lack of proactivity goes a long way towards explaining the lack of transparency over emissions. An industry characterised like no other by perhaps only five household names necessarily looks after its shareholders before anyone else. "Big business is basically self-regulating, with little regard for the planet," Booth said.

A shocking example of this is happening right now in Newport, South Wales. Booth's heart sank when he discovered a brand-new data centre facility standby power system was being powered by 60 diesel generators of 1MW each. "Come on guys," he told me. "You're building a brand-new facility, why aren't you thinking about using innovative standby power systems in South Wales?" Digging a little deeper, he told me, the problem is 20th century architects putting designs forward for 21st century data centres, when data centres aren't their core business. In this case, they specialise in other types of buildings - shopping centres and so on; data centres aren't their core focus, so there is a lack of knowledge in their company about the innovative data centre solutions available."

What's being done?

There are initiatives like the Climate Neutral Data Centre Pact operating in Europe and The Green Grid in the US encouraging self-regulation and open reporting, which have set themselves impressive zero-emissions targets. The hope is that if these are effective a global initiative will be rolled out, but these are membership organisations and not compulsory calls to action. Even the UN Paris Accord makes no specific mention of data centre regulation, with the most recent document available produced in 2012, almost ten years ago.

As we have seen, only a fraction of those 8.2m data centres worldwide are regularly reporting their PUE (Power Usage Effectiveness). Chris Demers of Supermicro summed it up. "Self-regulation initiatives enable energy efficient data centers but are only part of the equation. Consumers, hosting services, data center operators, builders of IT infrastructure, and regulators all have agency – and must understand the CO2 emissions and PUE attributable to data centers by its choice of electricity generation, building efficiency, power management solutions, and core IT infrastructure."

Those big tech companies will have signed pledges to report within those pacts, but John Booth is cynical. "Individual companies make a lot of noise about their own sustainability but it's about PR; it's the absolute minimum they can get away with." Data centre websites crow about their achievements all over the internet but there are very few impartial reviews supporting their statements, so how green they really are is questionable. Scratch away at the surface and all sorts of convenient tax breaks are taking place, making these headlines about great PUE seem rather hollow.

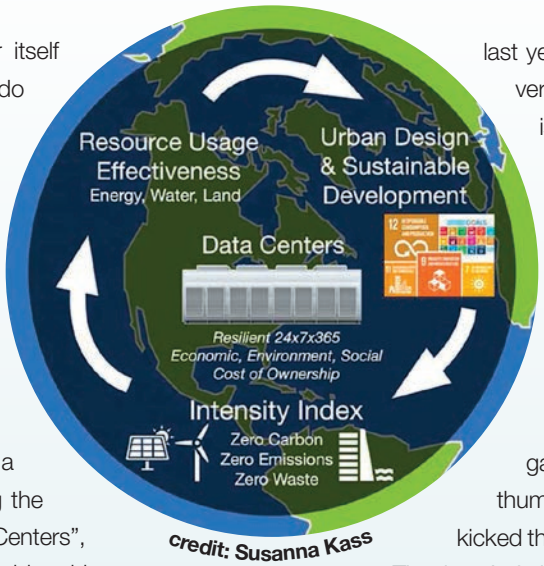
Improbably situated between towns with the magical names of Bend, Alfalfa and Madras in Oregon is the small town of Prineville. Once a fading frontier town with little to look forward to, it now boasts the monolithic Facebook Data Centre, which proudly reports its PUE every half hour. Apple have a data centre in Prineville as well. Mike Rogoway of The Oregonian reported that "Both companies chose Prineville because of low land costs and cool desert night air to chill the data centres' computers. Above all, Apple and Facebook chose Prineville because of tax breaks that exempt them from most local property taxes. Crook County records show those tax breaks saved Apple $16.4 million last year and $9 million the year before."

One would think that in 2021 it is considered cool to be green; big brands are all over this now and consumers vote with their feet, opting for a restaurant that donates surplus food over a washing powder that pollutes. It seems extraordinary that the

Inside a Google data centre [credit: Google]

data centre sector is not falling over itself to adopt green policies that actually do some good, outsourcing the marketing, enabling them to bask in the glory.

Susanna Kass, Climate 50 member and Data Centre Advisor to the UN's Sustainable Development Goals programme has literally made it her life's work to ensure the next generation of data centres is as emission-free the world over. In a paper entitled "Designing and Building the Next Generation of Sustainable Data Centers", she advised that data centres "should achieve a PUE as close to 1.000 as possible and a WUE (water usage effectiveness) as close to 0.000 as possible. Part of this will require cooling that uses virtually no power and little to no water. Data centres must also transition to being powered by a renewable, emission free, and water neutral energy source."



credit: Susanna Kass

A background in computer science led to a stellar career at Sun Microsystems, Hewlett Packard and eventually saw Kass as COO at Ebay in the early 2000s, an integral part of building the e-commerce giant and trading community we all know today. Such growth has come at a sizeable cost to the planet however.

"A few years ago my daughter told me off for not recycling and, while I understood the science, the emotional impact was missing for me. She was crying because I didn't recycle plastic properly. It made me reflect. I realised we have to be responsible. I wrote a white paper. I wanted to say sorry for what I did, then announce what I want to do in the future. I described a data centre in the form of a life cycle. Ultimately, we need a symbiotic relationship with nature."

"We have the technology to remove carbon from the data centre industry. We can repurpose heat from a data centre to warm houses and grow food. Doing nothing could actually lead to water shortages for us all in the future. Leadership takes ambition and it also takes a plan. If each company only worries about their own parameters that's insufficient. We all need to worry about this on a global scale."

Another issue facing the sector is its short-term outlook; like other industries, politics especially, legacy is only considered in terms of the positive impact on the decision-maker's own career. Combined with technology developing at a rapid rate and the demand for data doubling year on year (especially last year). This makes long-term forecasting very difficult. Booth estimates five years is about as far ahead as anyone is looking. "The fast pace of change doesn't help to plan," he explained. "Planning for growth is very difficult when you think a 100MW data centre could be 50% too small in 5 years' time. It's a gamble to look so far ahead, but then you might be in the situation where you hadn't gambled enough." Recent populist tub-thumping and the pandemic have also kicked the debate down the road; in 2019 Greta Thunberg's furious expression was everywhere, now she is back at school, the media obsessed with Coronavirus.

Being good neighbours

The tension between cynical, self-regulating big business and the blue-sky optimism offered by sustainability experts seems depressingly evident, as does the aching cultural chasm between those running the data centres and those relying on them. The over-use of words such as *must* and *should* when discussing solutions is disheartening given the alarming statistics and demand for data that surely will only rise as time goes on, broadband speeds increase and the remaining 45% of the world take possession of an iPhone.

But is it really that bad? In spite of the problems outlined, John Booth and Susanna Kass were both in an ebullient mood. "The future looks bright," John said. "We are going to see a lot of innovation, and we'll see smart city concepts becoming a reality. We are going to have to become good neighbours. Once we get more diverse and world-aware people running things, the industry will boom." Susanna smiled and said, "I think we will get there." Like turning a supertanker though, this will clearly not happen quickly. The intention seems there across the board, but it is going to take affirmative action, diplomacy, tenacity and maybe Greta Thunberg's generation to make it a reality.

*The BBC Science Focus fact was tellingly caveated: *Update 23/01/2020: It's been brought to our attention that these figures are now out of date. We've gone back to our expert to get a new answer – watch this space.*