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4 Powering 'smart' futures: data centres and the energy politics of digitalisation

Digital energy futures

From large-scale projects to compute climate data, socio-technical experiments with 'smart' energy grids and 'smart' cities, to the attempts of traditional energy companies to decarbonise through alternative fuels, post-carbon futures are imagined as digital and ethereal by corporate capitalism, governmental, and supra-governmental organisations. These imaginaries hinge on an old but still powerful idea that sees digital technologies and information flows as immaterial, and thus carrying the promise to enact 'post-industrial' societies that are not driven by the extraction and consumption of fossil fuels. Contemporary enactments of this idea flourish in public, industrial, and engineering discourse through imaginaries of 'sustainable' planetary futures moulded with the help of AI, predictive analytics, algorithmic-driven automated decision-making, and practices of data mining, all coordinated and produced in the cloud.

A vibrant and still emergent scholarship at the nexus of the anthropology of data and critical studies of media infrastructures has sought to go beyond these dominant narratives and to understand what shapes them. This scholarship has insisted on the crucial importance of adopting a situated perspective on cloud computing and the digital industries and infrastructures that support it, and have recognised the materialities and geologies of digital infrastructures and technologies (Hogan 2015, Dourish 2017, Brodie 2020a, Taffel 2021, Velkova 2021). It has explored the (geo)politics of their physical emplacement in particular geographies – through attentiveness to submarine fibre-optic cables, data centres, the mines of rare materials that power AI and cryptocurrencies (Starosielski 2015a, Lally, Kay, and Thatcher 2019, Crawford 2021, Johnson 2019). It has also drawn attention to what is discarded and left behind (Gabrys 2013, Liboiron and Lepawsky 2022, Brodie and Velkova 2021). This expansion of data, and the infrastructures, ecologies, and labours it requires, means we need to set a research agenda assessing present and future impact.

Within this emergent field of research, data centres – one of the most visible manifestations of cloud infrastructure – have provided a valuable entry point for exploring and engaging with new questions of the environmental impact of an increasingly digital world (see also Ch. 2). Inside data centres, the growing vol-

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umes of data produced by the Internet-connected devices that we interact with on a daily basis are stored, processed and transferred. These buildings remotely deliver the apps, software, and computing resources that digital societies increasingly rely upon. Imagined as the 'engines of the Internet' (Alger 2013), data centres allow switching from one network to another and provide the computing and storage power that is essential to the smart digital futures being peddled by corporate strategists and government policymakers.

This chapter engages with these visions by questioning these smart and sustainable futures through a glaring blind spot: the data centres that underpin these futures are themselves energy-intensive enterprises. These buildings consume an incredible amount of energy to power and cool the computing equipment they contain. This can place burdens on local energy suppliers, leading to energy shortages for the neighbouring communities, as shown by Clément Marquet, Andrea Pollio, and Liza Cirolia in this chapter, thus reshaping local energy futures.

This chapter also intervenes by engaging with the unforeseen futures created by the extraction and use of natural resources and the reworking of local geographies entailed by the construction and running of data centres. Amidst growing public and political awareness about the environmental costs of data centres, data centre providers are engaging in efforts to 'green' their infrastructure. As such, considering data centres as an empirical object foregrounds the ways in which digitalisation, in its current form, both exacerbates problems of energy provision and environmental pollution, and fundamentally refigures and transforms local energy cultures (Strauss, Rupp, and Love 2013) and infrastructures, creating new relational entanglements between energy and data as argued here by Patrick Brodie and Alix Johnson.

In doing so we draw on ethnographic research to demonstrate the importance of the past in defining the shape of emerging systems, and identifying the pressure points at which they are disrupted, which will invariably shape the future. To engage with this ethnographically we explore relations of energy and data through the energy problems, politics, and promises of the data centres that underpin 'smart' futures through four cases. The cases investigate countries across the global North and South, in heavily urbanised as well as in less densely populated areas, addressing the presumed opacity of data centres by gaining access to these built spaces as well as around them, while also conducting research with municipal officials, energy operators and their neighbouring communities, among others.

Data centre energy: illusory anticipation

Data centres require electricity to power the hundreds (often thousands) of servers that they contain, as well as the air-conditioning systems that are used to keep the servers cool. These buildings have been estimated to consume 200 terawatt hours (TWh) of electricity each year – more than the national energy consumption of some countries (Jones 2018: 163–164). In doing so, they can cost their operators around $4 million per annum in electricity alone (Taylor 2018) and significantly raise the electricity consumption of whole countries (Danish Energy Agency 2018). Servers are far more energy efficient than they were a decade ago. However, due to their increasing deployment, they often consume the same, if not more, energy. This is a good illustration of Jevons’s (1865) paradox, which, as Sy Taffel (2021: 11) succinctly explains, occurs when ‘gains from increasingly efficient use of a resource fail to result in reduced consumption of that resource.’ As of 2018, data centres were estimated to account for 1% of global electricity demand and to contribute roughly 0.3% to overall carbon emissions (Jones 2018: 163–164).

While data centres form the foundations of the digital future, they are often still powered by carbon fuel. For example, the average European renewable uptake was greater than that of fossil fuels in 2020, at 37% and 38% respectively (Eurostat 2022), although this varies considerably from country to country. Moreover, renewables are no panacea (see also Ch. 3), as they are dependent upon atmospheric movement and meteorological conditions. Concerns thus abound in the data centre industry as to the stability of the electricity provided by renewable power sources.

Other resources are also needed to power data centre equipment. For instance, the air conditioners require large amounts of water to cool the servers. Water has been identified as a key actant within data centre ecologies (Hogan 2015). During water shortages or droughts – which will increase in some parts of the world as climate change accelerates – the servers would quickly overheat, causing service disruptions and failures (Hogan 2015, 2018, Gilmore and Troutman 2020). A situated perspective on the cloud and data centres reveals energy systems as increasingly integrated with digital technologies for measuring, tracking, and distributing water, air and electricity, as well as forecasting consumption and generation. At the same time, as some data centres make the switch to renewable energy sources, they increasingly become entangled with elements of the environment that are often perceived in the industry as less predictable, such as wind (Bresnihan and Brodie 2021), thus revealing unforecasted futures.

Preparedness arises as a guiding logic of the data centre industry, providing data centres operators with a framework for anticipating and managing threatening futures (Taylor 2021a, 2022a). With any downtime potentially resulting in significant loss of revenue, data centre providers strive to ensure that their services will continue to be delivered under any circumstance by anticipating a range of speculative disaster scenarios – from earthquakes and hurricanes to unprecedented spikes in demand. This anticipation of future disaster often results in excessive amounts of energy consumption, with data centres leaving their equipment idling on standby in case there should be a sudden surge in demand (Holt and Vonderau 2015: 83, Taylor 2021b: 78). Preparedness leads to overprovisioning, with excess capacity remaining a standard operating condition (Taylor 2021b). Tung-Hui Hu (2017: 83) has thus suggested that data centre energy practices are driven by visions of future need translated into the present: 'The equation that converts an imagined crisis in the future into present capacity is why the cloud wastes so much energy.'

The politics of placing data centres

Alongside scaling up carbon-powered data centres, Big Tech (predominantly the 'Silicon 6' – Google, Apple, Amazon, Microsoft, Facebook, and Netflix) have sought to green their infrastructure in order to maintain and secure their market relevance and capital positions during the large-scale global transition to renewable energy. One recurring strategy has involved placing data centres in 'naturally cool' regions abundant in hydro- and wind power such as the Nordic countries, Ireland, the Netherlands, the US Pacific Northwest, and Québec. In these regions data centre providers can take advantage of the cold or windy climate to help keep their servers cool, reducing their cooling requirements and costs (Vonderau 2018). This has led Asta Vonderau (2019a) to observe that, within the regional investment strategies of Nordic municipalities, cold air is increasingly being reconceptualised as a natural resource that can be used to attract data centre development, with the hope this will lead to regional development.

The corporate rhetoric surrounding these developments has followed the same template and mobilised similar language, focusing on strategies of 'climate compensation' and 'carbon offsetting,' which have taken two forms. One has concentrated on building data centres in Europe powered by 'local, clean' energy, while the other on building wind and solar power plants owned by Big Tech that would match the capacity of the fossil-fuelled data centres in the US, turning Big Tech into important players in the transforming field of renewable energy provision and becoming energy providers. Research has demonstrated how these developments are generative of new frontiers of extraction that entangle renewable sources of energy built by local, public investments with the supply chains of global data capital (Bresnihan and Brodie 2021), thus simultaneously reproducing and extending earlier paths of colonial-driven capital accumulation and bypassing national communities. The contours of these emerging energy and data geographies and their implications for futures are only beginning to be mapped by social scientists, requiring further analysis for which this chapter seeks to lay the groundwork.

After the global financial crisis of 2008, European politicians and corporate lobbies helped frame data centres as new digital industries that could revive local economies (Brodie 2021). In response, national governments started to compete with each other, by zoning disused or abandoned industrial landscapes in urban and rural peripheries, or areas considered to be 'wastelands' into 'data-centre-ready' land, and reducing the cost of electricity needed to power data centres. This regional competition has given rise to a market landscape every bit as speculative as the forms of property development that drove the financial crisis in the first place. The ever-changing market dynamics and corporate strategies for computing geographies has left behind a trail of abandoned data centres or 'cloud ruins' (Brodie and Velkova 2020).

Ethnographic engagements and encounters at sites of data centre development and industrial exchange have been a key aspect of many studies of the data centre industry, whether among local communities affected by data centres (Burrell 2020, Brodie 2020b, Maguire, Watts, and Winthereik 2021, Vonderau 2019b) or industrial settings (Burrell 2020, Brodie 2021, Johnson 2019, Velkova 2019). They shed light on the social conflicts related to the extent to which local politics and common goods have animated local identity struggles bound to place and locality (Brodie 2020b, Burrell 2020, Mayer 2021, Vonderau 2018). Big Tech have extended social tensions and divides, reanimating historical conflicts embedded in the historical legacy of internal colonial dynamics and rural underdevelopment. As it quickly becomes apparent that data centres do not significantly improve regional welfare, local communities have tried to find value in other aspects of data centre operations. A range of initiatives are underway that aim to direct the waste heat generated by servers into district heating systems (Velkova 2016). This enables data centres to reduce their waste footprint while remaining firmly grounded in the carbon regime that powers their servers. As Julia Velkova (2021: 665) argues, these energy initiatives, 'simultaneously serve computing machines, the platform economy and old energy monopolies, while not necessarily breaking apart from the carbon regime.' If datafication is going to play a central role in energy futures, then it is increasingly important that data centre providers are brought into discussions with energy providers, municipal leaders, and urban planners. Data centres will need to feature far more prominently than they currently do in strategies and designs for more sustainable energy futures.

The cases

We present cases of contested data centre energy futures from around the world, including France (Clément Marquet), Iceland (Alix Johnson), South Africa (Andrea Pollio and Liza Cirolia), and Ireland (Patrick Brodie). These cases demonstrate the value of ethnography as a mode of accessing the social, cultural, political, and environmental side effects surrounding data centres, and exploring how their presence reshapes the future. Marquet's long-term ethnography of the Plaine Commune territory, a deprived region of Paris, offers an illustration of energy tensions at the local level, tracing frictions between electricity providers, local residents, and the data centres that have taken root in this urban region. These tensions are also present in Johnson's case about the data centre industry in Iceland, despite the country's abundance of renewable energy which attracts companies wishing to green their consumption. Johnson draws our attention to the political construction of Iceland as an energy island defined by its geographic isolation and its abundance of renewable energy. Pollio and Cirolia highlight the complexity of running one of Cape Town's first co-location data centres in an energy-deprived country, revealing its paradoxical dependency on past infrastructures and its invisibility. Path dependency shapes data centre energy presents and futures. This is also clear in Brodie's case, which unravels the tangled web of past and present circumstances on and around a peat landslide in rural Ireland caused by the construction of an access road developed to provide renewable wind energy for data centres in Dublin.

The cases highlight ethnographically the tensions between data centres, their energy consumption, and their uneven geographical distribution. They reveal the inconsistencies in public policies, the weakness of legislative powers to counteract the social and environmental costs of data centres and the new geographical and social inequalities they create. In doing so the cases emphasise the importance of ethnographic analysis as a tool for investigating how Big Tech companies participate in the production of futures framed by digital technologies which increase energy consumption and exacerbate energy inequalities. Thus, engaging with dominant visions of smart energy futures critically, the cloud and data centres become situated through the political-economic and colonial relations that are constituted by the hunt for cheap energy and resources to power them (see also Ch. 5), and the pre-existing power asymmetries and forms of exclusion these relations entail. As such, the cases shed light both on how data centres reconfigure futures and how ethnography can bring unheard voices and alternative futures to local and national governments and other stakeholders.

Contested data centres and energy futures in Paris’ Plaine Commune

Clément Marquet

It is 15 January 2015: around 80 people are gathering in rue Rateau in La Courneuve, in the north of Paris, a rather poor suburban city part of the Plaine Commune urban community, known for high unemployment rates, immigration, and energy insecurity. As the crowd stops, Jade Lindgaard, a journalist and ecological activist, takes the microphone to say:

> I invite you to turn towards this metallic grey building and to look at it carefully. It is interesting to compare this building, its aesthetics, its size, to the other buildings of this street, namely houses, which date from some 20 years ago, of one or two floors, facing this metallic parallelepiped which dominates them and breaks the aesthetics of the street (figure 1). You can’t see it from the outside, but it’s a data centre. A data centre of the company Interxion, but no sign indicates it. From our point of view, this invisibility is part of the problem of data centres.

This fieldwork snapshot is an excerpt from a ‘Toxic Tour’ organised by a local ecologist group. Toxic Tours are a demonstration technique (Barry 2001) used by environmental justice activists to attract attention to the correlation between polluting infrastructure and inequalities. The Toxic Tours organised in Plaine Commune aimed at showing the entanglement between climate and social and environmental inequalities, and that the territory was gridded by polluting and noisy infrastructure, motor roads, airports, and data centres which did not benefit the local citizens and caused environmental damage.

Unknown to the citizens and most of the elected officials, data centres have been silently mushrooming for years, thus considered as ‘invisible’ by the Toxic Tour activists. Between 1999 and 2015, fifteen data centres thrived in a rather small area, leading politicians to promote their territory as ‘the French capital for the data centre industry’ in 2009 and journalists to qualify the area as the ‘golden triangle of cloud computing in France’ (Dupont-Calbot 2013), a reference to the shape of the former industrial area, bordered by a railway in the west, the

Fig. 4.1: Interxion Data Centre Par7 facing the houses of the rue Rateau. Photo by author.

Parisian ring road in the south, and the Saint-Denis canal in the north-east, crossing Aubervilliers and Saint-Denis.

Between 2011 and 2015, the proliferation of these infrastructures started to raise concerns about their energy implications, their economic contribution, and their urban integration: local energy providers, environmental agencies, financial services, and city dwellers sent alerts to the municipality. As a result, in La Courneuve the operator has been sued and two Toxic Tours organised to uncover the issue to a wider audience.

Drawing on the sociology of public problems (Dewey 1927, Cefaï and Terzi 2012) and on urban infrastructure studies (Larkin 2013, Graham and McFarlane 2015), this case explores the micropolitics of trouble (Emerson and Messinger 1977) regarding data centres installations, while issues related to climate change and the energy transition became increasingly important in urban policies and for residents. The case unravels how energy infrastructure, energy precarity, and space allocation became central in the debates and rendered data centres politically visible in Plaine Commune, and how environmental critics failed to produce political changes regarding data centres. I have conducted twenty interviews between 2015 and 2018 with elected officials, public bodies, neighbours, data centres consultants, and architects. Since then, I have also conducted observations through the regular attendance of data centres professional fairs in France, and analysed the grey literature (reports, environmental impact assessments).

From energy abundance to the threat of virtual energy shortage

Only in 2009 did local elected officials start to pay attention to the data centres settled in Plaine Commune and turned those infrastructures into an asset for local economic growth. Jean-Yves Vannier, a freshly elected official in charge of Urban Planning, Economic Development, and Sustainable Development, met several experts in data centres to discuss the development in the city of Aubervilliers. As data centres generate important revenue for local taxes and occupy warehouses taken up by activities providing little revenues like wholesale businesses, he envisaged that data centres could become an asset for urban planning and a tool for economic gentrification. To carry out this project, he reached an agreement with Data4, a French operator of neutral co-location data centres, and planned a 15,500 m^2 data centre.

In 2011, the energy provider Enedis warned the Plaine Commune elected officials that energy was lacking in the territory, and suspended all new data centre installation until the building of a new power substation. This was mostly due to the practice of overbooking electricity, an economic strategy that takes advantage of Enedis's reservation system for economic purposes: 'I realised that the data centre operators were waging an incredible war on each other by reserving electrical power to block the competitor's development,' Jean-Yves Vannier told me. Unable to exclude economic competitors by purchasing land as too many brown fields were still available, data centre operators have exploited the electricity reservation system to gain an economic advantage in Plaine Commune's golden triangle.

The story might have ended with the provider's alert and the suspension of data centre installations. However, Jean-Yves Vannier, eager to have a new data centre in Aubervilliers, made the issue public. 'In order not to have the technical contingencies as a political compass', he asked the administration of Plaine Commune and the energy supplier for the construction of a new energy substation, infrastructure planned and built in a longer time-frame than data centres. To force the decision, he called journalists and contributed to the publication of a press release entitled 'Energy shortage threatens Plaine Commune's data centres' (Le Parisien 2011). While the article made Enedis's lack of provision responsible for slowing local economic development, it started to raise the administration and city dwellers' concerns about data centre power consumption.

Tax reform and energy transition

While Jean-Yves Vannier was urging the administration to invest in a new substation, data centre growth became a matter of concern and in 2010, Plaine Commune's Urban Ecology Department was asked to implement the Territorial Climate Energy Plan (TCEP), a program with quantified objectives to act locally on climate issues.

Defined by European guidelines, these plans aim to reduce greenhouse gas emissions and energy consumption by 20 %, and to reach a threshold of at least 20 % renewable energy in final consumption by 2020 at the intermunicipal level. In an interview, the territorial civil servant in charge of the TCEP mentioned the contradictions in which he finds himself as he is asked to encourage already energy-poor residents to reduce their energy consumption, while elected representatives allow energy-consuming infrastructure to settle without any debate. And, as data centres were bringing revenues through local taxes, they were almost unchallengeable.

In 2012, a report analysing the economic impact of the 2009 national reform of the business tax revealed that the economic contribution of data centres was drastically lower than expected as, between 2009 and 2011, data centres tax revenues had dropped from €12.6 m to €1.5 m, an 88 % decrease (Service des études financières 2012). The note questioned the role of data centres in Plaine Commune's fiscal resources, as 'data centres require a lot of space and energy'. The Urban Ecology Department of Plaine Commune used this alert to investigate data centres.

In 2013, territorial officers and a local environmental agency produced the first French expert report analysing the technical, urban, and ecological impacts of data centres (Leicher 2013). This report had three objectives. First, to provide a technical understanding of data centres, as most of the elected officials and territorial officers had little knowledge about this activity. Second, to create a debate between the elected officials of Plaine Commune in order to define a common political ground regarding the territorial climate commitments and future data centres. Third, to propose instruments to support such a policy position and to regulate the future installation of data centres: the authors suggested constraining the location of data centres to reuse waste heat and suggested new environmental indicators in order to assess the collective and environmental contributions of companies and make data centres comparable to other projects.

However, the presentation of this report to the Plaine Commune Board of Directors raised strong differences between the elected officials, as those in favour of data centres argued that they were essential to economic development (and therefore should not be regulated). Since the disagreements were too great, the absence of consensus favoured the pro-data centre actors.

From local protests to climate mobilisation

The tensions surrounding the data centres did not remain within the administration and these infrastructures began to be contested on the street in a fight opposing the rue Rateau dwellers to Interxion’s data centre Par7, a co-location neutral data centre (Fig. 2). The Interxion data centre was built in two stages, 2011–2012 and 2013–2014, in order to avoid an administrative procedure requiring environmental authorisation due to the hazardous nature of the data centre as the building stores nearly 580,000 litres of fuel to power generators in the event of a power outage, a feature requiring a longer administrative procedure, including a public inquiry.

During the summer of 2013, an inquiry took place while the first half of the building was already commissioned. Residents felt cheated as they learned that the massive, ugly, and noisy building facing their home was also a potential fire hazard or could even explode. In response, they launched a petition which obtained 424 signatures, and took Interxion to court with an environmental law firm.

As their struggle began to be publicised, the climate activists who were organising the Toxic Tours in the Seine-Saint-Denis department joined them. Data centres were reported as consuming a lot of energy and land without creating many jobs in a territory known for low incomes, energy precarity, and high unemployment. Moreover, the Seine-Saint-Denis has a long history of the struggle against environmental damage caused by motorways and airports. Data centres were presented as polluting and undesirable infrastructure contributing to climate change.

In October 2015, the case against Interxion Par7 took place. At first the residents won as the court invalidated the procedure and suspended the ongoing authorisation. This decision implied that Interxion’s clients would have to withdraw their servers within a few days because of a procedural error. However, the local administration softened the decision two days later: Interxion could pursue its activities, but had to produce another procedure in due form.

Fig. 4.2: In the background, Par7 the data centre of Interxion, overhanging the houses of the rue Rateau. Photo by author.

Epilogue

In 2021, the story of data centres in Plaine is still ongoing. Two hundred metres away from the rue Rateau, Interxion has started to build a new data centre campus in La Courneuve (Fig. 3). This campus has been celebrated by the operator in the media as one of the largest sites in Europe. In a local press article, the journalist quoted an Interxion executive, asserting: ‘We are drying up the electrical capacity of the sector’ (Debruyne 2020) thus notifying its competitors that no other data centre could settle in the area, due to a lack of power in the local grid. As the biggest data centre in the area, the campus secured 130 MW of electrical capacity. Answering to local critiques, Interxion explained its willingness to ‘offer heat to whoever wanted it’ (Debruyne 2020) – without saying who would pay to build a heat network locally – invest in training for unemployed people to provide jobs for the data centre industry, and build an 8,000 m^2 park which would be retrofitted in the city.

Fig. 4.3: First building (of four) of Interxion’s future data centre campus, construction site in La Courneuve, April 2021. Photo by author.

Discussion

Through the dynamics at play since the late 1990s in Paris’s northern suburbs, this case highlights how data centres are at the centre of contested territorial and energy futures as well as the relationships between data centres and energy temporalities.

First, it sheds light on how, amidst political and public blindness, data centres contribute to infrastructure concentration and impact the energy grid and supply. Data centres are an infrastructural reactivation of ‘dormant’ energy supply left vacant by older industries (Pickren 2017). The authorities hope to reap some benefits from their growth by promoting them as carriers of a new modernity, a revival of the Industrial Revolution that once brought wealth and employment (Vonderau 2019b, Maguire and Winthereik 2019). In the name of this new modernity, marketed as a revival of old industrial prosperity (be it true or not), these cloud infrastructures of the future are welcomed regardless of their needs in energy infrastructure, which are taken for granted (Lally, Kay, and Thatcher

2019). Yet, as data centres appeal for investments in energy infrastructure and foster the development of telecom infrastructure (fibre optic cables), they reinforce infrastructural concentration and path dependency mechanisms (see Brodie's case). But it is only when energy starts to be a matter of concern for various actors (future data centre operators, elected officials, and the national energy provider) that the relationship between data centres and energy becomes political and a subject of public and political inquiry.

Second, conflicting modes of anticipation appear between the energy provider Enedis and the data centre industry. While Enedis uses an anticipation instrument, the energy booking system, to manage local energy demands and forecast investments in power substations on a long-term and national level, data centres overprovision electricity to answer clients' demand (security, scalability, availability) and to secure future developments against economic competition. Energy issues regarding data centre growth and network planning are spreading across Europe: Amsterdam recently declared a moratorium on data centre installations (Judge 2020), and regulating data centres is a growing concern in Frankfurt (Judge 2021) and Dublin (Swinhoe 2021). What is at stake here is the production of new modes of anticipation (instruments, regulations) that can address the practices and politics of data centre energy and land management.

Third, the case highlights the frictions carried by the unrestrained spread of data centres and their uneven consequences. The multiple failures of the actors to problematise the link between data centres and energy, and their inability to produce a public debate about other territorial futures, stress the difficulty of protesting against this 'infrastructure of modernity.' By highlighting the potential danger to neighbouring communities, its inability to meet municipal climate commitments, and its contribution to climate injustices, the critics framed data centre development as an undesirable future at the local and global level and produced alternative narratives of territorial energy and climate futures. They proposed instruments (from the ecological indicators to the Toxic Tours) to make those alternative sociotechnical imaginaries exist. Nevertheless, each attempt to contest, expose, or inflect the consequences of data centres energy practices for the territorial future has been countered by arguments linking economic development and technological determinism. If, thanks to the mediatisation of local protests and the multiplication of expert reports, operators now must deal with their public image and accept trade-offs in local negotiations, the future energy challenges are still secondary for the operators and the collectivity while data centres secure their own energy future.

The energy island

Alix Johnson

The first time I felt the interplay of hot and cold air inside a data centre, it immediately called to mind – or, more accurately, to body – another new experience I was having in Iceland, where my research on these digital infrastructures was based: the cross-currents reminded me of the delicious indulgence of cranking up a radiator while opening a window to the winter winds. Icelanders, I had already learned, did this often, as a way of enjoying some fresh air in a season spent overwhelmingly and unavoidably inside. Raised as I was with an attitude of Midwestern frugality, and in an era of energy conservation campaigns, I was shocked by the idea of letting heat out of a warm house. But Icelanders, with their crisp and cosy homes quickly convinced me – in Iceland, unlike any other country I had lived in, neither the cost, nor the carbon footprint of their heating (provided through geothermally warmed water), was a concern. So I had started, tentatively and then with abandon, cultivating this atmosphere inside my own apartment, savouring the feeling of falling asleep amidst a light breeze. It was this feeling that returned to me standing in the data hall, reaching around to feel the heat seep out behind the server rack, while cool air rose steadily from the floor beneath my feet. But unlike the exchange of air inside my apartment, in the data hall heat and cold were precisely controlled.

As Mateo, my guide that day, explained: ‘the principle of data centre design is separating and containing hot and cold air.’ Because computation generates heat as a by-product, and too much heat stresses servers and other hardware, cooling is a central concern for data centre operators – and a major expenditure. Meticulously separating the hot air produced by servers from the cold air used to cool them down makes striking such a balance more efficient and cost-effective. So, at the data centre in Southern Iceland where Mateo (an American veteran of the data centre industry) worked as Director of Technical Services, servers were organised into a common industry configuration of ‘hot’ and ‘cold aisles’: servers are stacked on racks, which are arranged in back-to-back pairs, and every other row is sealed within its own little glass room. Cold air, filtered up through the floor, is blown into the front of each rack, while the hot air emitted from the back of the servers is trapped in the aisle behind them, then channelled up and out of the room. This delicately engineered environment, Mateo told me, keeps servers running reliably within a thermal window of 68 and 71 degrees Fahrenheit (20 – 21.7 degrees Celsius).

So while my own moment of embodied recognition in the data centre conjured a condition of energy abundance (the ability to run a heater against wide open windows), Mateo's explanation of the data hall's organisation drew my attention to practices of energy containment, instead. As it turns out, and as I wish to explore in this short piece, both dynamics are essential to the project of drawing data centres to Iceland in the first place. Both constitute Iceland as a kind of energy island, a place known for energy production that is unlike, and crucially *unlinked to*, anyplace else.

Over the past decade, scholars and industry observers have noted a northward migration in the data storage industry (Holt and Vonderau 2015, Vonderau 2019a). This is because the work of cooling servers is made easier if the environment surrounding the data centre is already cold: where other sites have to pay for air conditioning, in Iceland Mateo likes to say, 'we just open the windows' (although, of course, as we have already seen, the reality is somewhat more technically involved). In addition to its cold, Iceland's appeal as a data centre site is enhanced by its abundance of renewable energy: its national grid is comprised of 73 % hydroelectric and 27 % geothermal power, and produces 55,000 kWh per person annually, as compared to the European Union average of 6,000 kWh (Government of Iceland n.d.). This energy abundance is reflected in promotional materials that aim to attract the industry to Iceland: commissioned reports, brochures, and websites all cite statistics surrounded by sumptuous natural imagery, rushing rivers and steamy rifts that signal the promise of power. Energy abundance is substantiated in the twelve-year contracts the national power company is able to offer data centres, as the pricing of renewables is more predictable than that of fossil fuels.

But it is not only Iceland's capacity for energy production that matters to data centre developers (and the clients they seek to attract): the isolation of Iceland's grid counts for something too. In a public talk Mateo gave in 2016, at an industry conference called World Hosting Days, he explicitly contrasted Iceland with mainland Europe: The European power grid, he explained, 'is interconnected by seventy per cent. I'll translate that for you: a power outage or disturbance in Macedonia or Portugal can take out parts of Germany – it has happened, and it will continue to happen.' In Iceland, by contrast, Mateo said: 'You're an island.' This means that Iceland's energy is 'non-dependent on any imports, non-dependent on any other grid.' In framing the island as wholly separate and self-sustaining, Mateo emphasised that it was insulated from risk – Iceland's servers would stay online, whatever happened in Macedonia or Portugal.

At the same time, others have pointed to the ways that interconnection compromises, while Iceland's isolation keeps its power 'pure'. For example, one Icelandic cloud services provider coined the moniker 'Truly Green' to distinguish itself from the competition: while other companies claimed to be 'greening' on the basis of carbon credits that offset emissions, or mixed grids with a growing percentage of renewable power, Iceland's almost fully renewable – and completely independent – grid meant that data stored and processed by this company was 'truly green' in a way that others could not claim (Høvsgaard Nielsen 2014). It is, then, not only Iceland's abundance of energy that makes it appealing to the data centre industry; it is also, perhaps equally, the containment of that energy – the construction of Iceland as an energy island.

By 'energy island' I mean that Iceland is an island associated with energy production, but also that Iceland is an energy producer associated with isolation. Unlike the complexly interconnected grids of Europe (which Mateo warns against in his talk), Icelandic energy is produced and consumed here. It is, in fact, this place boundedness that makes 'Icelandic energy' legible as a concept at all: Icelandic energy is that derived from landforms on the island, and put to use within its national borders, which coincide neatly with the extent of those landforms. Like another set of energy islands, the Orkneys, which Laura Watts (2019) traverses in *Energy at the End of the World*, energy here emerges at the volatile nexus of environment and innovative engineering; through the relationship between a people and a place experienced as an earthly 'edge'. But unlike in the Orkney Islands, no cable connects Icelandic energy to any mainland; no contracts make Icelandic energy accessible outside. Instead, the specific benefits, and situated nature of that energy are* what draws data centres (and others) to Iceland: they actually need to be on the island to partake in its promises, to access the abundance available here. Doing so, they avoid the risks, and sidestep the PR pitfalls, of more distributed sources of energy. Iceland's islandness would seem to offer the data storage industry an exception to business as usual; an energy elsewhere or escape.

Islandness, however, is not just a self-evident geographical state of being; it is also a freighted cultural imaginary. The fact of Iceland's small size, relative remoteness, and surroundedness on all sides by the North Atlantic Ocean have long been mobilised and made meaningful, from both inside and out. In antiquity, Iceland was associated with Ultima Thule, the conceptual endpoint of the knowable world; later, visitors to the island would emphasise its exotic difference and distance from the European mainland (Ísleifsson 2011). In Iceland's independence movement, nationalists invoked their persistence amidst the harsh conditions of island living as evidence of both a distinctive Icelandic identity, and the capacity of Icelanders to govern themselves (Oslund 2011). More recently, Iceland has been productively associated with the trope of the island laboratory, for example when the genetics company deCODE proposed to construct a national database of all Icelanders' medical, genealogical, and genetic information. As CEO Kári Stefánsson put it, Iceland's small and geographically isolated population made the island 'perhaps the ideal genetic laboratory' (Greenhough 2006).

But another trope of island living was activated after the construction of that genealogical database, when a team of software engineers won a design competition with 'Íslendinga-App,' an application that let users bump their phones together to determine if they were too closely related to date. 'The Icelandic nation is not inbred,' Kári felt compelled to tell *USA Today* following a spate of international media coverage of the 'anti-incest app': 'This app is interesting. It makes the data much more available. But the idea that it will be used by young people to make sure they don't marry their cousins is of much more interest to the press than a reflection of reality' (Associated Press 2013).

All this is to say that Icelandic islandness is not only a property of its land mass and location; islandness has also served as a framing device for claims and characterisations; it has sometimes functioned as a liability, and sometimes as a strategic resource. The 'lure of the island' (Perón 2004) does important work towards determining what kind of place Iceland is, and what kinds of purposes it can be said to serve. Particular notions of islandness get reified in these manoeuvres, from familiar notions of remoteness to the naturalisation of Icelandic nationhood. Today, key players in the data storage industry partake in this iterative inscription process, picking up on island imaginaries as they emphasise Iceland's geographical isolation. As Iceland is marketed as energy 'non-dependent' or as uniquely and 'truly green,' the island is cast as a space of exception where the regular rules do not apply. Reinforcing ideas of Icelandic distance and disconnection in order to carve out a new economic niche, the lines they draw around the island feel intuitive, as they trace in the grooves of lines drawn before. In this formulation, Iceland emerges not so much as a model of the renewable energy transition, an example to which other places could aspire; instead, it appears as outside, an otherwise, an escape hatch for an industry incentivised to cut both its costs and its carbon emissions, fast.

And yet. As scholars (and inhabitants) of islands have long argued, 'islands and continents are but names we give to different parts of one interconnected world' (Gillis 2004: 3). Data centres energy futures, likewise, are not so easily cordoned off or parcelled out. While the Icelandic national grid may be contained on the island, Icelandic energy both does work, and relies upon relationships with others, outside its shores.

These relationships might be said to have started in the 1960s with the arrival of the Alusuisse (which later became Rio Tinto Alcan) aluminium smelter at Straumsvík on Iceland's south-west coast. An infamously energy-intensive industry, smelters seek out inexpensive power contracts and move their operations accordingly; they were drawn to Iceland at the time for its hydropower, which drastically reduced energy costs as compared to oil. While early negotiations triggered controversy in Iceland over the growing influence of multinational corporations (Iceland, after all, had only gained full status as an independent republic in 1944), the aluminium smelter was approved and erected in conjunction with a hydropower plant at Búrfell. This dual construction project guaranteed the Alusuisse smelter a reliable long-term source of inexpensive electricity, as it doubled Iceland’s energy production capacity. At the same time, it set off a trajectory of twinned development – an aluminium plant for a smelter, a smelter for an aluminium plant – that has continued since. For example, in 2006 the Kárahnjúkur Hydropower Plant was built in conjunction with the Fjarðaál aluminium smelter (owned by Alcoa) in Reyðarfjörður on Iceland’s east coast. More recently, geothermal drilling in the Hellisheiði area has also accelerated to meet aluminium smelters’ needs (Maguire 2020). Each of these projects has been controversial in its own way – the Kárahnjúkur dam aroused protests for its environmental impacts (Magnason 2006) and the acceleration of geothermal drilling in Hellisheiði has produced a profusion of anthropogenic earthquakes in the region. But these linked projects of expanding infrastructure and expanding industry have produced Icelandic energy on an unprecedented scale; they have made Iceland the world’s largest electricity producer per capita.

‘Icelandic energy’, then, has long been international. Of course, the energy itself, to borrow Watts’s term, ‘Icelandic electrons’ (2018), is derived from Icelandic land forms and accessed primarily through Icelandic labour, innovation, and expertise. But the creation of ‘Icelandic energy’ as a branded commodity, and the development of the national energy grid into an appealing industrial resource, has been negotiated in relation to multinational companies, aluminium smelters specifically. It is through these relations that Iceland has become known as a kind of ‘energy island’ at all. From one angle (and one viably held viewpoint in Iceland), this development has been an economic success story: in 2018, aluminium smelting accounted for over 17% of Iceland’s total exports (Iceland Chamber of Commerce 2019); it has been vital in diversifying an economy once tethered almost entirely to the sea. But from another angle, the outsized influence of multinationals that sceptics warned about in the 1960s has come to pass: heavy industry now consumes 77% of electricity in Iceland (Iceland Chamber of Commerce 2019), while benefiting from labour reforms, tax incentives, and environmental exemptions (Skúlason and Hayter 1998).

If in the second half of the twentieth century, Icelandic energy was primarily marketed as being inexpensive (an influential 1995 pamphlet produced to attract power-intensive industry was straightforwardly titled ‘Lowest Energy Prices’), today Icelandic energy is known for being green. It is its almost entirely 100% renewable constitution that appeals to companies pressured to address their carbon footprints, such as the data centres increasingly approaching Iceland as a place where their electricity consumption can be both easily accommodated and conveniently contained. Environmental scholars and activists have long drawn attention to the ecological costs of even ‘green’ energy, the real harms done by damming and drilling, and the sacrifices these practices often entail. But here I wish to emphasise the work done, and the strategic opacities enacted, by the construction of Iceland as an energy island defined by its abundance and isolation.

Imagining and describing Iceland in this way positions the island as an escape: here, energy-intensive industry is shielded from the risks of interconnection, as well as exposure to public critique. Iceland appears an irresistible outside to norms and trade-offs that seem unavoidable elsewhere. But energy futures take their traction from energy histories, and the concept and function of Iceland as an energy island have been constructed through (often compromising) international relationships. As data centres step into a legacy largely made by the aluminium industry, they raise some of the same questions about foreign corporate interests and the application of Icelandic energy (Magnússon 2015). Today, data centres consume more energy than all the households on the island put together (and recall those open windows and radiators running on high) (Ingólfsson 2019). Based on anticipated industry expansion, power shortages are predicted in Iceland in the coming years (Stefánsdóttir 2019). And so, while the expansion of the data-storage industry has not yet commissioned its own new power plant – its own extension of Icelandic energy infrastructure in its interests – such a project has now been placed on the table, a plan for developing a hydropower plant in Iceland’s West Fjords that would likely serve data centres ever-increasing needs (Guðmundsson 2019).

Iceland, then, is not an energy island ‘naturally’ suited to the data centre industry. As we have seen, the energy abundance on the island has been historically, and is continually being, engineered in the interests of others; meanwhile, the infrastructures that channel this energy are not ‘isolated’ but instead developed in intimate relation to international needs. Like the cross-currents of hot and cold air that hit me inside the data centre itself, Icelandic energy may appear a natural profusion, but is in fact carefully directed by design. Rather than a matter of ‘just opening the windows,’ data centres are practically sustained in Iceland by a dense network of interconnections. There is no escape then, no meaningful outside to the exorbitant and growing power demands of digital data. Offshoring data centre operations may make these less visible, but does not do away with the collective responsibility of managing their many costs. Much as we may long for an energy island, our energy futures are indelibly linked.

Engines of the Internet: South Africa’s energy-data nexus

Andrea Pollio and Liza Cirolia

On a crisp July morning, we – three urban scholars and an energy expert – were consuming miniature cupcakes and coffee sitting in a windowless boardroom inside one of Cape Town’s first co-location data centres. After several rounds of biometric security, we had been generously met by the head of marketing, accompanied by a small team of bubbly engineers. The centre had become, over recent years, Africa’s largest neutral Internet Exchange (IX). Yet the reasons for our desire to visit the facility went beyond a mere curiosity with South Africa’s recent Internet history. With local elections around the corner, two issues kept appearing in Cape Town’s political debate: incessant load-shedding – that is, rolling electricity blackouts across the city and country[1] – and the development of Amazon’s new African headquarters on a contested brownfield site just outside the city bowl, an area known as Two Rivers Urban Park (or TRUP for short).

While elections have since passed, load-shedding and debates over TRUP have not. And, although the two issues might seem unrelated, they are in fact two facets of the inextricable nexus of energy and data in Cape Town, a city which has played and continues to play a unique role in the development of the global cloud in Africa and beyond. As far as energy is concerned, our field trip was born out of a keen desire to understand how notoriously energy-hungry data centres function in a country where the generation and the distribution of electric power are in a seemingly endless crisis. Despite this, South Africa houses Africa’s lion’s share of data hosting capacity, with two-thirds of large-scale facilities on the continent (Pollio and Cirolla 2022a). Early in 2020, for example, Amazon announced that the city would be the site for the first African node of their global cloud services AWS, thanks to servers in three different facilities. Although these data centres remained unnamed, it was very likely that we were indeed visiting one of them. But there was more to Amazon’s story: in Cape Town, a decade and a half earlier, a small team of Amazon software engineers developed EC2, the software backbone of AWS (Pollio and Cirolia 2022b). Facilities like the one we toured, therefore, attest at once to the recent, uniquely local, history of the cloud and to its energy futures.

1 In South Africa, load-shedding is the result of separate development policies during apartheid, which delivered an unequal infrastructuring of the country, and of decades of mismanagement of the country’s national energy utility in the democratic era.

Our tour had begun with a lengthy PowerPoint presentation. As our hosts spoke, artists' impressions and aerial images of new facilities being built all over the country alternated on the screen. But unlike those renderings of new, large-scale, purpose-built premises, older data centres are often housed in very unremarkable buildings: concrete structures that previously functioned as telephone exchanges, former warehouses wedged between residential properties, or underground garages of commercial buildings. In our case, our trip had taken us to an office complex in Rondebosch, a leafy suburb perched on the slopes of Cape Town's famous Table Mountain. Surrounded by tall plane trees, by the 1950s the office building had replaced one of the colonial farmsteads which once dotted the area, and whose old Dutch and English names still identify streets and properties. Today, the refurbished complex hosts a mix of IT companies, asset management firms, a couple of law firms, and, in its underground belly, Africa's densest web of network switches.

To reach the data centre, we walked past the hallway of the building, with its glossy marble floors and whitewashed walls, and descended to a level below the ground. Compared to the opulent corporate feel of the levels above, the data centre interiors featured a mix of high-tech and very functional, no-nonsense aesthetics. While waiting for our hosts, a stream of couriers would come in and out, carrying boxes of various sizes and disappearing into the corridors. It felt like being at the entrance of a bustling underground anthill. 'In a way, we are the landlords of the Internet,' we were told by our host. But while the metaphor of the landlord evoked ideas of ownership, our hosts meant the exact opposite. 'As a neutral facility, we just rent out the space and make sure that the lights are on. We have no idea about what happens inside the server cabinets.' As an example, one of the engineers anecdotally mentioned a content distributor, one of the companies that are licensed by media firms such as Netflix to make their content available outside their native jurisdictions. He told us that they had come with their own cabinet and that if somebody tampered with it or touched it, the servers inside would wipe themselves and self-destruct. The idea seemed quite extreme, but we guessed it was also a cautionary tale so that we should not touch anything during our later visit. We all naïvely pictured one of us poking a little yellow cable protruding from a cabinet and shutting off Netflix for the whole continent.

And so our conversation went on for several hours. Our energy expert took the lead. An established consultant working on just urban transitions and deeply concerned with the fracturing of urban systems, she asked detailed questions about the procurement and supply of the large amounts of electricity necessary to power the whole machine. With often unpredictable load-shedding – resulting in blackouts which would last for spans of two hours several times a day – ensuring continuous power supply, despite uncertainty, was a full-time job for our data centre. It turned out that the data centre reported paying Eskom, the national power utility, an exorbitant monthly bill. While the details of the contract were not disclosed to us – for example whether or not it included a reserved quota of electricity – large commercial and industrial premises all over the country are in a constant, usually unsuccessful, negotiation with Eskom to be spared from load-shedding. And although we had not yet ventured into the server rooms, we all felt that we had entered a big engine made by a network of smaller machines, each made of an even smaller webwork of switches, processors, disk drives, and power units singularly innervated by a lattice of electric cables.

The impression of having walked into an engine became even more intense when we were eventually guided into one of the server rooms. A loud whirring noise surrounded us, an imperceptible vibration almost indistinguishable from the dense, lukewarm air and the slightly noxious smell that made some of us pleasantly light-headed and others increasingly anxious and claustrophobic. This low murmur is the result of a very simple phenomenon. Processing units are, after all, conductors of electricity. As electrons travel through the unit, they collide with other particles inside the medium, releasing energy in the form of heat. The more a processing unit heats up, the less it is capable of performing, and the more likely it is to lose data. Therefore, as described by Johnson in her case, each server is equipped with small fans that push warm air out of the server cabinets into the so-called hot aisles, from which this exhaust air is extracted, filtered, and cooled down before being recycled. Cool air is then fanned into the cold aisles, narrow corridors onto which the server cabinets open. The low humming noise is the compounded result of all the fans and the air-conditioning units that continuously keep each part of the 'engine' at its appropriate temperature. The containment of hot and cold air in these narrow aisles is the latest architectural technology in what has been a very fast evolution of how data centres have become better and better at reducing their energy consumption. And yet, as our data needs increase, so does the energy needed for hosting them an industry that already churns out 1% of global carbon emissions (Masanet, Shehabi, and Lei 2020). Africa's contribution may be a very small portion, but is also the fastest-growing destination for data hosting, and questions about how this industry's needs for power and water will be met remain to be answered.

Scholars of digital infrastructure have indeed variously shown how data depend on other resource-intensive grids: not just energy, but also water supply (Hogan 2015), and, in African cities, alternative networks of distribution (Guma 2019). The geography of data also follows older infrastructures, from railways (Burrington 2015) to telegraph lines (Starosielski 2015a, 2015b). Shannon Mattern has argued that there is a spatial path dependency between new and older media systems (Mattern 2017). For this reason, while global tech corporations are experimenting with relocating data facilities underwater or in remote Arctic sites, older facilities like the one we visited are here to stay. The dense web of connections that have been built, incrementally, as the centres have grown, would be incredibly difficult to move geographically. We realised this as we walked past the IX room, a nondescript door with a rounded porthole window. Our guide did not let us in, but explained that the matrix of connections inside was so inextricable that it would be impossible to physically move to a new location. So while purpose-built facilities can be assembled in more efficient ways (even underwater!), old switching networks may remain for the foreseeable future in the ageing buildings that first housed them. But there is more. Not only are these knotted networks here to stay, but what seems to be the thermodynamic relationship at their core is also here to stay.[2]

Understanding this relationship begins with taking seriously the sensory experience of having entered an engine. Engines are human artefacts that transform power into work. While the mechanical work of a traditional engine and computing work are obviously not the same, the notions of computing data and work are so entwined that the first time the word computer was ever used it referred to (female) workers (Light 1999). If data centres are industrial-size engines doing computing work, then perhaps they are not too dissimilar to modern factories, which emerged in the late eighteenth century as an architectural and logistical project to organise the relationship between two forms of work: human labour, and mechanical work produced by the steam engine (Daggett 2019). Data centres still have this relationship at their core – the optimisation of different forms of work and the energy required for them (Hu 2015: 89–90). Therefore data centres may become more efficient, but their energy futures are still couched in their pasts, in the social and physical thermodynamics of work and energy. In this sense, data centres like the one we visited are not just revealing of the fact that the internet is a very spatial matter, but also of the relationship between computing and energy, which too depend on the infrastructures that have built cities over decades. These fixities, therefore, at once depend on and inform what Louise Amoore has called ‘cloud geographies’ (2018).

In many African cities, these geographies inevitably intersect with the path dependencies of colonial spatial planning, which resulted in only partial urban

2 At least until quantum computing becomes the norm, although some speculate that superconductors (i.e. processing units that do not produce heat because they are kept in a cryogenic state) will never fully replace normal CPUs.

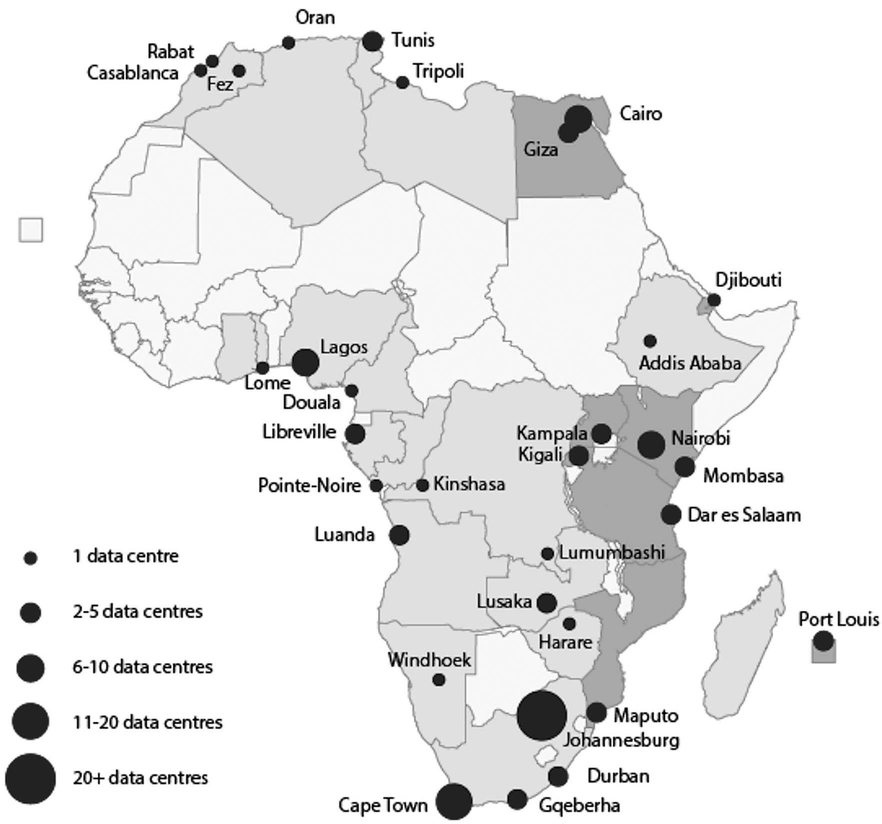

Fig. 4.4: The uneven (and) urban geography of co-location data centres in Africa as of August 2021. The booming data hosting industry in Africa, due to spatial legacies of colonial infrastructure, is an almost exclusively urban phenomenon. Map drawn by the author based on the Cloudscene database.

networks for grid infrastructure. In Cape Town specifically, the need to have centrally located data centres also circles back to Amazon's unique history in the city, where the software behind the first commercial cloud was developed and where thousands of software engineers keep being hired to experiment with making remote computing work more efficient. Similarly, the data centres that host Amazon's servers keep building energy-efficient resilience against load-shedding. The nexus of data and energy is what anchors the cloud to specific locations in Africa. As we were writing this sketch, Amazon announced the construction of a large solar plant to power its servers in a country and in a continent that still struggles to meet energy requirements for much more basic needs. The irony of these entanglements is that one doesn't need to travel a long distance from the data centre we visited to find large suburbs where the infrastructural promises (Von Schnitzler 2016) of the South African constitution are far from being a reality.

As we left the data centre, several hours after entering, we looked back at the old building between the withered winter leaves of the plane trees: a building we'd seen many times on the way to our university campus but never really noticed. We also passed the neighbouring care home, whose guests with advanced hearing aids, we had been told, kept complaining about the obnoxious and endless whirring sound that would haunt their unique auditory frequency. We could not help but wonder whether they'd ever been told that the sound was the murmur of the Internet, the whirr of one of its engines converting energy into work.

Clouds and bogs

Patrick Brodie

In November 2020, a video surfaced on social media of a catastrophic peat landslide adjacent to a wind farm construction site in County Donegal in the Republic of Ireland (ROI) near the border with Northern Ireland (NI). The landslide was caused by the construction of an access road for the Meenbog Wind Farm being developed by Invis Energy, a Cork-based joint venture by Irish- and English-based stakeholders, who had in 2019 entered into a contract with Amazon Web Services (AWS) to provide energy for their data centres in Dublin, serving the US multinational's commitments to renewable energy. The access road, like the planned wind farm, was being built over a vast blanket bog landscape. In press materials, AWS are largely absent from discussion about the landslide, in spite of only months before being praised for their climate responsibility and investments with regards to the wind park (Quann 2019) – in fact, it appears as though their links to the landslide were scrubbed from some initial reports, and they have directed all media inquiries towards Invis Energy (Corr 2020).

This ethnographic case unravels the tangled web of circumstances surrounding this peat landslide and its aftermath through the lens of current and historical infrastructures and ecologies. To do so, I will present a series of empirical vignettes through which we can understand the entanglements of culture, land, territory, resources, people, and politics when faced with the externalities of data centres' energy demands and their administration along infrastructural networks colonised by private capital. Most of this research occurred during the 2020 (and 2021) Covid-19 pandemic, where many researchers have found that '"the field" withdraws further and further' from us (Vemuri 2022), and most data collection has happened via Twitter, frantic Googling, and poring over any policy, planning, and media documents available. Thus much of the research is reflexive/reflective, narrativised through examples that seem disconnected but work together via the intensities and entanglements of Ireland's histories and infrastructures. That said, I was lucky enough to briefly visit the site of the Meenbog Wind Farm construction site and landslide with a colleague on a wet, rainy day in June 2021 and speak informally with some people involved in protesting against it and other large-scale infrastructures being developed in the region, which afforded the opportunity to photograph and reflect on the place with my boots on the soggy ground and learn from the experiences of those who knew that something like this could happen.

Path dependence

Fig. 4.5: High capacity pylons crossing the Barnesmore Gap in Donegal, Ireland. Photo by author.

My colleague and I were stopped at an automated traffic signal for construction on the N15 at the Barnesmore Gap in Donegal. We were not sure what the roadworks were, but I was struck the day before, when I had passed through in the other direction, towards the west coast of Ireland from the north, that a trail of high capacity overhead electrical pylons followed alongside the road, which itself followed along a decommissioned railway track, most recently under the governance of the County Donegal Joint Railways Committee from 1906 to 1960, which incorporated the earlier West Donegal Railway connecting Stranorlar in the mountainous Finn Valley with the town of Donegal closer to the West Coast. The line had first been established in the late 1800s by the British colonial authorities, who oversaw the creation of an extensive railway network connecting the reaches of the largely rural, agrarian island of Ireland, making accessible its various resources, agricultural, and labour forces.

The Gap itself was much more ancient, its dramatic location between two peaks in the Bluestack Mountains partially carved by the retreat of glaciers cutting across the once-frozen landscape 13,000 years ago, creating what today appears as a natural passageway across the landscape. The blanket bog which carpets the rock formations underlying the Gap and its surrounding mountains is a direct ecological remnant of these retreating glaciers, as thousands of years of low-lying plant decomposition – most prominently the Sphagnum, or 'bog-builder', moss which creates a pillowy bed across the underlying, semi-aqueous peat reserves – created the complex soil formations that have long been harvested and used for household cooking and heating and industrial energy and agricultural purposes. Swathes of these blanket bogs are still beholden to the ancient Turbary Rights of local residents, or the right to use certain plots of land for turf-cutting, and veins of drainage, excavation, and stacks of dried peat made by small-scale turf cutters are visible for miles across many of these largely uninhabited landscapes, even in the shadow of 115 m high wind turbines and alongside sprawling evergreen plantations.

The existing energy, transport, and industrial infrastructure thus followed in a layered path dependence of prehistoric geology, pre-colonial settlements, colonial governance, and postcolonial development, wherein the conditions of the 'Anthropocene' and its modes of production and uses of resources entangle the atmosphere, land, infrastructure, and people. These existing routes of development are increasingly becoming important for Ireland's 'green' transition.

Wind farms, like data centres, are built along and to fit into these existing networks and pathways; often assembled along the border and/or on otherwise undeveloped bog landscapes, they must be assembled on land that is suitable (in the case of bogs, land seen as good for nothing else), but must also be at least marginally linked via existing infrastructure to transport enormous turbines for installation and electrical cables to distribute electricity to substations, storage, and the grid. Where these networks do not already exist (and often even where they do), they must be fashioned through enormously transformative and disruptive means by, for example, widening rural roads, creating new access roads through inaccessible landscapes, laying new cables, constructing new pylons, and building new substations. Thus the distributed networks in which wind farms take part, far from 'undergirding' the everyday life of locals in rural Ireland, have tended to disrupt or bypass them, whether overhead pylons transporting energy elsewhere, roads closed, or expanded only for large lorry transport, or fibre-optic cables underfoot bringing data to and from Dublin and the oceanic cable connections on the west and north coasts.

Deep peat

Peat is a carbon reserve; when dried and extracted it acts as a hot burning, dirty carbon fuel for individual or industrial activity. But while remaining in the ground it actively stores atmospheric carbon. Intact peat bogs in Ireland, as of 2005, stored 1,085 megatons of carbon, equivalent to 53% of Ireland's soil carbon stores in only 16% of the land area (Irish Peatland Conservation Council 2020). For this reason, bogs have come to the attention of many environmental scientists, especially those involved in carbon accounting, over the past few decades as a viable site of carbon sequestration. Left in a 'natural' state, peat bogs can be made valuable as 'sinks' for human pollution and be mathematically used to offset carbon emissions elsewhere. Once they are drained and cut, much of that carbon is already released into the atmosphere, from the ground into the air. When these are rewetted, they will eventually become active, and store carbon once again. For this reason, government grants are now being offered to farmers and landholders to leave their bogs alone, not developing them or using them for grazing or turf-cutting – whether in the interest of local or regulated conservation or the planetary science of sequestration.

The large-scale, high-tech infrastructures of renewables and Big Tech exist in stark contrast to the forms of underdevelopment that still characterise much of the country, especially the oft-disconnected border region, whether lack of broadband access or other connectivity. This is an energy story as much as an access story, as energy systems transform to accommodate more 'responsible' energy consumption. The non-fossil fuel central heating systems, for example, are unevenly available; – in 2017, four out of ten households in Ireland still used oil for heating, but 66.4% of households in the border region used this form of fuel while only 11% did in Dublin. Similar to oil, homes in border counties Leitrim (8.9%) and Donegal (11.1%) still rely heavily on peat for heating compared with only 5.4% countrywide (Central Statistics Office 2017). This high level of individual household carbon demonstrates the ongoing reliance on localised, small 'e' energy, as Larry Lohmann calls it (2016), while large-scale renewable energy remains unavailable for heating unless new technologies (e.g. for retrofitting) become affordable and widely available, for now pooled into a grid that can heat their computer's battery but not the air in their home.

We got back in the car and followed the pathway of the N15 to the Meenbog Wind Farm construction site, which was just on the other side of the construction on an access road with a small sign. We were hugging the border – only a few miles across the mountains, past the job site, was County Tyrone, in NI, and the site of the landslide. Access to the job site was restricted, unless you were a turf-cutter that needed access to the surrounding bogs to take advantage of turbary rights. Works were meant to be halted on the site while an investigation into the cause of the landslide was ongoing, but several cars passed through the gates as we wandered. Signs marked warnings against trespassers and environmental hazards in the area as we left the site: 'Deep peat.'

Fig. 4.6: Sign cautioning about 'deep peat' at the entrance to the Meenbog Wind Farm construction site in Donegal, Ireland. Photo by author.

'Like a blister'

The Meenbog Wind Farm has been under development since 2016, and has been a subject of great controversy, especially in Finn Valley, where the Finn Valley Wind Action Group has been lodging complaints and objections against other local wind farm developments since at least 2015. In 2019, while planning was still underway for Meenbog, AWS and then-Taoiseach (Prime Minister of ROI) Leo Varadkar announced publicly that the company would be buying 100 % of the projected 91 MW of energy produced by the wind farm, another step in fulfilling their pledge to eventual 100 % renewable energy use. In this arrangement, wind energy does not go directly to AWS' data centres, rather pooling in the grid with other energy, and AWS' energy contracts would simply ensure that some of that ends up with them, allowing them to put on paper that they are 'committed' to renewable energy while avoiding any direct responsibility for its development (either positively or negatively rendered). In his statement, however, Varadkar publicly celebrated the deal as a direct example of AWS' climate commitments and contributions to the Irish economy (Quann 2019). The project is now one of three wind farms covered by corporate power purchase agreements entered into by AWS in Ireland, joined by projects in Cork and Galway.

Before AWS entered the picture, the planning application for 49 wind turbines at Meenbog was initially denied after a series of environmental appeals, leading another wing of Invis' parent company to apply for a second, smaller-scale planning permission for 19 turbines. This second attempt was successful, in spite of earlier zoning rules forbidding wind farm development due to 'proven environmental sensitivity' (Corr 2020), demonstrating the often competing sustainability claims mobilised through the bogs. AWS only entered into the project once the red tape had mostly been cut and environmental impact assessments completed (however partially), to avoid public service levies, as the project would be entirely unsubsidised by public funds. Locals were 'baffled' to hear that AWS was involved in the project (Kiernan 2019), especially after so much controversy, and coming from the mouth of no less than the Taoiseach of Ireland, paving the way for approval before any had actually been reached. To their knowledge, AWS officials had not directly engaged in any public hearing or consultation with local communities, signifying that AWS' 'investment' in the wind farm was a contract with another corporation and not with local interests.

The Finn Valley group as well as the Gweebarra Conservation Group continued to raise serious concerns about the integrity of the peat bog on which the turbines would be built, and across which a network of access roads would have to be constructed. These roads across the bog are called 'floating roads', as they essentially sit on top of largely aqueous peat bog, which sits underneath most of the landscape on the surrounding mountains, whether planted with sitka spruce trees or left in a more natural bare state for grazing, turf-cutting, or conservation. Conventional wisdom from those most involved and knowledgeable about the landslide says that it was caused by the construction of the access road to one particular turbine upstream, from where it spilled into the Mourne Beg River. A digger excavating the ground had popped an underground reserve 'like a blister that ruptures' according to one hydrologist (qtd. McSweeney 2021), sending a layer of peat down the hill and into Tyrone in NI and its water supply and fisheries. We were told by residents that people fishing the water had pulled up catches with black peat clogging gills. The scale of the fish kill reportedly would be hard to estimate due to the scale of the peat pollution, which could have been obscuring death underneath. NI and ROI authorities both told residents not to worry about damaged water supplies.

Fig. 4.7: Aftermath of the peat landslide on a bogland site crossing Donegal, Ireland and Tyrone, Northern Ireland. Photo by author.

Walking on the hill to observe the fallout of the landslide, which was still extremely visible more than six months after the initial slippage, I was struck by just how remarkably unsuitable for construction this land must have been. Most of the bog essentially felt like walking on a waterbed, as you bounced and could see the ripples undulate for several metres away from your feet. Occasionally the bog became even squelchier, sucking your boot into it for stepping on a patch unsupported by plant roots. This was the muck that lay underneath, from 5 to 20 m deep, storing centuries of decayed plant material in its depths. To engineer this landscape for wind farm construction required excavation through the entire peat store, to get to the more stable rock formations underneath in order to plant concrete to support the turbines.

Conclusion

Inspired by Anne Pasek, who tells us that a Microsoft data centre complex in Virginia can be told through a story of ‘concrete and coal ash’ (2019), this particular data centre and energy story can be told perhaps through clouds and bogs, atmospheric and geological systems colonised by big tech capital. While appearing as ‘externalities’, they are actually constitutive of the systems themselves. The links in the data and energy supply chain traced above are becoming battlegrounds against Big Tech and its visions of a green future administered by their profit motives. Whether wind farms or pylons or battery storage, these links in the data and energy supply chain offer concrete sites of the struggle against a ‘future’ that we are told is already here.

Narrativising these connections is as important as mapping them, as it is often the connections between these sites that appear arcane or incomprehensible. But they are connected culturally, infrastructurally, and environmentally; people know these systems that cross through their communities and the landscapes around them, and how they connect with broader political and economic formations. An objector to a battery farm in border County Leitrim (ROI), proposed by Canadian multinational Brookfield Renewable Partners, could not only map out the watershed that would be affected in the case of storage failure, he could also point to where the energy lines coming in and out of the neighbouring substation went, which continued onwards from near Dromahair to a hydropower plant in Ballyshannon and then across the nearby border into NI. Border, energy, and nature stories coalesce within the ways that people understand the vast systems that govern and dictate their paths, while systemic forces like the state and corporations enact different forms of spatial transformation and expertise that frequently come into friction with existing ways of knowing and interacting with these places.

The reflections offered here may seem disconnected, or relatively scattered, as they unravel the entangled economic, cultural, political, and environmental factors involved. It may also seem that, in the peat bogs of rural Donegal and Tyrone, I have drifted far away from data centres, worlds away from the 'databelt' that surrounds Dublin. Even with the mere contrast of wind farms with the small-scale energy cultures of turf-cutting that coexist in these spaces, it seems more of an 'energy story' than a data centre story. In many ways, this is undeniably correct, as ultimately Amazon is simply creating demand for renewable energy that would, hopefully, be built anyway to substitute for declining fossil fuel reliance. Data centres may be an infrastructure peculiar to a particular kind of 'smart' and 'green' industrial formation emerging as the quintessential makeup of the 'Industrial Revolution 4.0', but they remain only one part of a vast system of energy and data infrastructures powering the data economy, private companies suctioning energy off public grids while proclaiming that they are shaping their constitution by developing renewable energy. In Ireland, as elsewhere, there is no separating the island's energy story from its data centre story anymore, nor from its industrial-scale green transformations. This eco-modern transformation will fundamentally reorganise Ireland's energy systems and its distribution of electricity across the island, something which will inevitably affect anywhere else that shares in the benefits and problems of the island's data and energy systems.

Even though Ireland is an island, its energy systems, along with their externalities, have political and material effects and influences far beyond its shores. Whereas in Iceland the abundant renewable energy is produced and contained within the island, Ireland's energy infrastructure remains carbon-intensive, in transition, and increasingly connected to wider energy systems as it is already connected to Great Britain by two existing undersea interconnectors. Island-wide renewable energy plans rest almost entirely on wind energy, and Brexit threatens the unity of approach that will be necessary for wholesale, island-wide transformation. In response, a planned interconnector between Ireland and France will plug Ireland directly into the European grid.

Next steps: energetic ethnographies of digital media infrastructures

Nathalie Ortar, A. R. E. Taylor, Julia Velkova, Patrick Brodie, Alix Johnson, Clément Marquet, Andrea Pollio, and Liza Cirolia

As anthropologists and social scientists engage in the analysis of the multifarious issues raised along the nexus of energy and data futures, they provide a much needed compass that helps reject instrumental, teleological views on digital futures. The issues that we have discussed in the introduction and the cases show how societal and planetary benefits from digitalisation and ‘smart’ futures are neither inherent to nor automatically produced by digital technologies and infrastructures. On the contrary, the emplacement and energopolitics of data centres (Boyer 2019, also see Ch. 3) in specific places reproduce in many respects well-trodden paths of industrial extraction. They create new issues for the communities at the centre of these developments by generating new social and identity conflicts and reactivating questions of modern infrastructural provision that have long been taken for granted in particular geographies. Taking inspiration from this scholarship, we propose five empirical interventions needed to expand these perspectives and move forward research on energy and data futures.

First, ethnography is uniquely positioned both to reveal the kind of invisibilities which are at stake and to mobilise the processes of making things visible which enables alternative futures to emerge. The data centre industry is commonly presented as a secret, opaque, and invisible industry (Blum 2012). Therefore we have underlined how those infrastructures tend to be both invisible (Graham 2016) and hypervisible, whether that is through the colourful pictures released by Google and Facebook (Holt and Vonderau 2015); through data centre marketing and promotional practices (Taylor 2021a); through negative press coverage about data centres’ energy consumption; or through narratives of local and national business attractiveness. This work has demonstrated that multiple layers of in/visibility shape and structure the data centre industry and the futures that this industry underpins. In/visibility is a relational feature of infrastructures – what is invisible for some is often highly visible for others (Star and Ruhleder 1996) and what matters is how (in)visibility is mobilised, by whom, and why (Larkin 2013). To paraphrase Larkin, the politics and poetics of data centres emerge through the practices, troubles, and issues that make specific aspects of Internet infrastructures in/visible.

Second, we need to take local concerns and forms of agency, resistance, or debate seriously in discussions about the futures enabled by data centres and the in-

frastructures that help enact digitalisation. Policy and scholarly analysis have to pay closer attention to the silenced publics who are infrastructurally incorporated in new relations between the digital economy and the energy politics of climate change. The build-out of new energy required for these practices similarly follow fault lines of uneven industrialisation, meaning that energy generation required for the growth of data centres tends to offer minimal benefit to ordinary energy consumers like households and small businesses. Amplifying local voices and value conflicts illuminates ultimately what is at stake in the negotiation of power, both literal and metaphoric, as well as the conflicting values that enter into friction with the entanglement of data and energy.

Third, data centres' energy futures lie in past social and physical thermodynamics of work and energy while creating new patterns which are part of their ambiguity. Data centre operations are entangled and dependent on multiple infrastructures such as roads, abandoned industrial zones, heat and electricity provision plants, bogs and peat extraction farms, as well as the humans who keep all of these operational (Taylor 2019, 2022b). Taking these entanglements as a focal point of analysis lets us powerfully illuminate the socio-material and knowledge practises through which data centres reanimate questions of local energy transitions, environmental justice, infrastructural path dependencies, and manifold forms of colonialism. Data centres' energy futures invite us to foreground the spatial dynamics of path dependency patterns. Indeed, if 'older media networks have laid the foundation for our modern-day systems… the 'old' systems those we might regard as buried on the '"ower strata" – are also very much alive […] in contemporary infrastructural systems' (Mattern 2017: xxviii). New patterns are also emerging in the making of energy and technology futures, as different infrastructures may converge at one moment, giving traction and form to these futures. Yet material convergence does not automatically lead to the integration of the different economies of value, time, and care that underpin each of these infrastructures separately. The divergence in the latter acts as a force of instability that ultimately may lead to the disentanglement of converging infrastructures, and the reshaping or demolition of the futures associated with them.

Fourth, the concept of 'energy gentrification' (Libertson, Velkova, and Palm 2021) can be mobilised as a critical intervention to illuminate how local actors and livelihoods are transformed through the anticipatory energy demand for data centres, affecting and limiting local access to electricity. Most data centres and the digital futures tied to them are built on preparedness (Taylor 2021b, 2022a). While Big Tech's solar and wind-production power plants produce more renewable energy, they do not expand the grid capacity. This raises concerns about the grid's capacity to meet the needs of public facilities such as hospitals. The energy gentrification perspective highlights the trade-offs between common goods versus private interests. It is thus fitting to ask, what other forms of gentrification related to the energy politics of data centres emerge?

Fifth, future research needs to reckon with the Euro/US centrism of much of the discourse and research produced on data centres so far and acknowledge the need to unpack the ongoing unevenness of global cloud infrastructure and its future use to produce alternative narratives. Future directions of this research will need to account for how the imagination of these uneven geographies has excluded the growing concentrations of data centres *within* the ‘global south’ and the new forms of inequalities between the global North and South. Data colonialism combines the predatory extractive practices of historical colonialism with the abstract quantification methods of computing (Couldry and Mejias 2019). It will provide the preconditions for a new stage of capitalism that as yet can barely be imagined, but for which the appropriation of human life through data will be central. Such developments implore us to understand capitalism’s current dependence on this new type of appropriation that works at every point in space where people or things are attached to today’s infrastructures of connection.

Conclusion

With the scale and reach of Big Tech’s energy futures, a pressing question surfaces about the need to rethink the knowledge and approaches to data centres and their entanglement with energy infrastructures, by considering local and situated, human and non-human concerns, in order to empower local needs and communities. While in many ways the power enacted by Big Tech companies in energy systems is new, these processes of private power within public systems demonstrate the historical continuity of certain forms of value extraction and capitalist accumulation. The ‘transition’ we are witnessing from carbon-intensive modernity to ‘green’ industries and technologies in the post-industrial landscape has not, and will not, radically transform the foundational uneven circuits of capital that define current global systems of exchange. These systems will continue to enrol local communities and environments in different ways, along existing fault lines of access, exploitation, and abandonment. Acknowledging these facts requires a research agenda that will illuminate how the industrial infrastructures of the ‘fourth Industrial Revolution’ produce new extractive and energy-intensive industries and how this hampers futures in the name of technological progress, efficiency, and preparedness; a research agenda that ultimately gives voice to alternative futures.

By highlighting different ways of inverting (energy) infrastructure and data, the energy ethnographies of data centres we have discussed in this chapter illustrate how ethnography can be mobilised to disentangle the relations between materialities, flows, and data and energy capitalism.

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