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THE STONE IN THE CLOUD: PLANNING THE RESOURCE DEMANDS OF THE DATA CENTRE INDUSTRY THROUGH LAND USE LAW

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> [T]he internet . . . is not "nowhere." There are nodes in the internet, where great amounts of data come and go, and they do have real physical locations.[1]

> I hadn't bitten down on the fact that the very heat generated by the internet itself is a strong factor in global warming, which pretty much nixes any view that a more wired world will be a more sustainable one.[2]

INTRODUCTION

In 2011, Steve Jobs launched a new Apple product called the "iCloud" at the annual Apple Worldwide Developer Conference.[3] The iCloud was promised to be "a seamless syncing service for users' data, documents, music and photographs between devices".[4]

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1 David Byrne, "David Byrne: Breaking Up with the Internet" (24 March 2014), online: *Creative Time Reports* <creativetimereports.org/2014/03/24/david-byrne-breaking-up-with-the-internet>.

2 Will Self, "New Dark Age by James Bridle Review—Technology and the End of the Future", *The Guardian* (30 June 2018), online: <theguardian.com/books/2018/jun/30/new-dark-age-by-james-bridle-review-technology-and-the-end-of-the-future>.

3 The unofficial AppleKeynotes channel, "Apple WWDC 2011—iCloud Introduction" (13 March 2013), online (video): *YouTube* <youtu.be/KTrO2wUxh0Q>.

4 James Bridle, "Secret Servers" (13 September 2011), online: *Booktwo.org* <booktwo.org/notebook/secret-servers>.

James Bridle observes that Jobs "did something unexpected"[5] that day by concluding his presentation with images of a large Apple data centre in Maiden, North Carolina.[6] These images "showed a vast, windowless and ground-hugging white building, set in a deep forest, the size of several football fields and abutted by squat round cooling towers".[7] Earlier in the presentation, in an effort to sell the innovativeness of the iCloud, Jobs suggested that some people envision the "cloud" as merely "a hard disk in the sky".[8] The iCloud, he said, "is way more than that".[9] Indeed, as Jobs briefly revealed, the cloud is terrestrial, bound to large buildings containing thousands of hard disks. Despite its seemingly everywhere nature, "when . . . data is stored 'in the Cloud', that data is materially stored in a data centre."[10]

Though the definition of a data centre can vary,[11] at a high level, a data centre is a building that contains computer equipment running software designed to "process data requests—to receive, store and deliver—to 'serve' data, such as games, music, emails and apps, to clients over a network".[12] In this article, I explore this hybrid building and digital infrastructure aspect of data centres. I argue that data centres can be viewed as bleeding edge sites

5 *Ibid*.

6 The unofficial AppleKeynotes channel, "Apple WWDC 2011—iCloud Introduction", *supra* note 3 at 00h:37m:18s.

7 Bridle, *supra* note 4.

8 The unofficial AppleKeynotes channel, "Apple WWDC 2011—iCloud Introduction", *supra* note 3 at 00h:02m:57s.

9 *Ibid* at 00h:03m:16s.

10 Graham Pickren, "The Factories of the Past are Turning into the Data Centres of the Future" (2017) 8:2 Imaginations 22 at 23 [Pickren, "The Factories of the Past are Turning into the Data Centres of the Future"].

11 The definition of a data centre can change greatly depending on who you ask. See Environmental Media Lab, "The Data Center Industrial Complex: DCIC Ep.1—People, Imagination and Concrete" (10 November 2021), online (video): *YouTube* <youtu.be/TuIbZiZR61w>.

12 Kate Jacobson & Mél Hogan, "Retrofitted Data Centres: A New World in the Shell of the Old" (2019) 13:2 Work Organisation, Labour & Globalisation 78 at 82.

where boundaries between the tangible and intangible are contested and become blurred.[13]

As Jobs alluded, the cloud metaphor obscures its enabling infrastructure. A.R.E. Taylor has argued that "the cloud is not just infrastructure, it is also a lifestyle, sold to us and defined by ideologies of seamless continuity, and constant connectivity."[14] Through its promises of "transcendental and perpetual data storage"[15] the cloud obscures spatial and material dimensions of its underlying technology[16] as well as the related resource costs required to extend such a great convenience. What Bridle found remarkable in Jobs' presentation was his willingness to reveal data centre infrastructure during lifestyle marketing.

The release of the iCloud punctuated an important transition in the technology sector as "cloud computing", a service that "enables clients to access files over a network as if they are stored locally on their computer systems",[17] became widely available to consumers.[18]

Alix Johnson describes this transition as follows:

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13 In cartography, a bleeding edge is "that edge of a print, chart, or map on which the printed image extends beyond the normal margin to the edge of the sheet". Oxford English Dictionary, "bleeding edge, n. and adj." (March 2022), online: *OED Online* <oed.com/view/Entry/256765>. This article considers the data centre as an edge site between the digital and physical. As this article will explore, in some cases, the digital bleeds through these edge sites and terraforms the physical environment.

14 ARE Taylor, "Failover Architectures: The Infrastructural Excess of the Data Centre Industry" (19 May 2018), online: *Failed Architecture* <failedarchitecture.com/failover-architectures-the-infrastructural-excess-of-the-data-centre-industry/> [Taylor, "Failover Architectures"].

15 ARE Taylor, "Standing by for Data Loss: Failure, Preparedness and the Cloud" (2021) 21:1 Ephemera: Theory & Politics In Organization 59 at 60 [Taylor, "Standing By for Data Loss"].

16 Including, importantly, technological failure. See *ibid*.

17 *Ibid* at 72.

18 *Ibid* at 74–75: "access to scalable online data storage in dedicated data centres . . . had previously only been available for industrial-scale storage operations".

> In the mid–2000s the rise of distributed computing fundamentally changed most of our digital practice—whether or not we noticed the shift. As it became increasingly possible to store and process data at a distance, most computation moved from servers stored inside our homes and offices to data centers sited around the world. This phenomenon is commonly known as 'cloud computing'.[19]

As the cloud computing phenomenon grew, academics began questioning the materiality of the cloud.[20] Asking such questions as "Where does the Internet live?"[21] and "Why there?",[22] a body of scholarship, sometimes categorized as "critical infrastructure studies"[23] and "critical data studies",[24] began examining data centres as important sites of internet infrastructure[25] and critical

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19 Alix Johnson, "Data Centers as Infrastructural In-Betweens: Expanding Connections and Enduring Marginalities in Iceland" (2019) 46:1 American Ethnologist 75 at 76.

20 See e.g. Paul T Jaeger et al, "Where is the Cloud? Geography, Economics, Environment, and Jurisdiction in Cloud Computing" (2009) 14:5 First Monday; Krishna Kant, "Data Center Evolution: A Tutorial on State of the Art, Issues, and Challenges" (2009) 53:17 Computer Networks 2939; Vincent Mosco, *To the Cloud: Big Data in a Turbulent World* (Boulder: Paradigm Publishers, 2014).

21 See Jennifer Holt & Patrick Vonderau, "Where the Internet Lives" in Patrick Vonderau et al, eds, *Signal Traffic: Critical Studies of Media Infrastructures* (Champaign: University of Illinois Press, 2015).

22 See Johnson, *supra* note 19; Nicole Starosielski, *The Undersea Network* (Durham: Duke University Press, 2015).

23 See Zane Griffin Talley Cooper, "Of Dog Kennels, Magnets, and Hard Drives: Dealing with Big Data Peripheries" (2021) 8:2 Big Data & Society 1 at 1.

24 See Graham Pickren, "'The Global Assemblage of Digital Flow': Critical Data Studies and the Infrastructures of Computing" (2018) 42:2 Progress in Human Geography 225 [Pickren, "The Global Assemblage of Digital Flow"].

25 Or "cloudfrastructures", see Kathryn Furlong, "Geographies of Infrastructure II: Concrete, Cloud and Layered (In)visibilities" (2021) 45:1 Progress in Human Geography 190. See also Julia Velkova, "Data that Warms: Waste Heat, Infrastructural Convergence and the Computation Traffic Commodity" (2016) 3:2 Big Data & Society 1; Patrick Brodie & Julia Velkova, "Cloud Ruins: Ericsson's Vaudreuil-Dorion Data Centre and Infrastructural Abandonment" (2021) 24:6 Information, Communication & Society 869; Pickren, "The Global

inquiry.[26] This scholarship has subjected the cloud and its physical infrastructure to "new and important questions about labor, capital, politics, and power (in a variety of meanings of that word)."[27] Though there has been much scholarship investigating the large electricity and water demand of data centres,[28] as well as scholarship that situates data centres as sites of extraction within a complex socio-technological system,[29] there has been little legal scholarship that has analyzed these problems and assessed legal responses.[30] This gap in the legal literature might be due to a data centre's hybrid nature. As Taylor writes, "data centres exist in an

Assemblage of Digital Flow" *supra* note 24; Luke Munn, *Countering the Cloud: Thinking With and Against Data Infrastructures* (New York: Routledge, 2023).

26 See e.g. Jaeger et al, *supra* note 20; Mél Hogan, "Data Flows and Water Woes: The Utah Data Center" (2015) 2:2 Big Data & Society 1 [Hogan, "Data Flows and Water Woes"]; Jacobson & Hogan, "Retrofitted Data Centres", *supra* note 12; Pickren, "The Factories of the Past are Turning into the Data Centres of the Future", *supra* note 10; Asta Vonderau, "Storing Data, Infrastructuring the Air: Thermocultures of the Cloud" (2019) Culture Machine 1 [A Vonderau, "Storing Data, Infrastructuring the Air"]; Ingrid Burrington, "The Cloud is Not the Territory" (20 May 2014), online*: Creative Time Reports* <creativetimereports.org/2014/05/20/ingrid-burrington-the-cloud-is-not-the-territory-wnv> [Burrington, "The Cloud Is Not the Territory"]; Mél Hogan, "Big Data Ecologies" (2018) 18:3 Ephemera: Theory & Politics In Organization 631 [Hogan, "Big Data Ecologies"].

27 Nathan Ensemenger, "The Environmental History of Computing" (2018) 59:4 Technology and Culture s 7 at s 20. See e.g. Mél Hogan, "The Data Center Industrial Complex" in Melody Jue & Rafico Ruiz, eds, *Saturation: An Elemental Politics* (Durham: Duke University Press, 2021); Mél Hogan, "Facebook Data Storage Centers as the Archive's Underbelly" (2015) 16:1 Television & New Media 3 [Hogan, "Facebook Data Storage"].

28 See e.g. Eric Masanet et al, "Recalibrating Global Data Center Energy-Use Estimates" (2020) 367:6481 Science 984; David Mytton, "Data Centre Water Consumption" (2021) 4:1 NPJ Clean Water; Anders SG Andrae, "New Perspectives on Internet Electricity Use in 2030" (2020) 3:2 Engineering & Applied Science Letters 19.

29 See e.g. Patrick Brodie, "Climate Extraction and Supply Chains of Data" (2020) 42:7/8 Media, Culture & Society 1095; Johnson, *supra* note 19.

30 See however, Daniel Greene, "Landlords of the Internet: Big Data and Big Real Estate" (2022) 52:6 Social Studies of Science 904 for an analysis of the real estate investment trust corporate structure and its importance to large colocation data centre operators.

infrastructure blind spot, not quite visible enough to be widely understood as physical infrastructures but often not quite falling within the remit of cybersecurity."[31]

This article connects critical scholarship on data centres with a Canadian legal analysis and proposes a policy response to problems identified in the relevant literature as they relate to the potential environmental and extractive hazards related to the high resource demand of this industry. My analysis is rooted in the law and geography methodology and draws from the "burgeoning field of data centre studies"[32] in order to unpack "the complex ways in which the data centre industry imagines itself and generates specific imaginaries for the public."[33] My discussion is grounded in documentary research[34] as well as field work performed in Halifax, Nova Scotia whereby I visited three data centre sites in the municipality.[35]

By piercing the "cloud" metaphor, viewing data centres as material internet infrastructure, and situating them in a politics of extraction, I argue that data centre buildings should be subject to additional land use regulation. Land use law is a flexible site of regulation which can attend to local considerations as well as provide onramps for democratic participation and information sharing. If we do not attend to the planning of this industry

31 ARE Taylor, "Keeping Us Connected—Data Centres as Critical Infrastructures", *Medium* (30 April 2020), online: <medium.com/@aretaylor/keeping-us-connected-data-centres-as-critical-infrastructures-56d22adeb5bb>.

32 ARE Taylor, "Future-Proof: Bunkered Data Centres and the Selling of Ultra-Secure Cloud Storage" (2021) 27 J Royal Anthropological Institute 76 at 78 [Taylor, "Future-Proof"]. A field that, through its specific focus on the data centre, is perhaps distinguishing itself from its "critical data studies" and "critical infrastructure studies" lineage.

33 Jacobson & Hogan, *supra* note 12 at 79.

34 I have drawn from a variety of sources including journal articles, news reports, caselaw, industry press releases, government reports and websites, public corporate filings, and promotional materials.

35 This field work, or "infrastructure walk", stimulated "curiosity for material surroundings . . . [and afforded the] opportunity to consider what we *can* notice and what we cannot" in viewing a data centre [emphasis in original]. Dustin W Edwards, "Critical Infrastructure Literacies and/as Ways of Relating in Big Data Ecologies" (2021) 61 Computers & Composition at 8.

through zoning law, it can derail efforts to mitigate climate change and present energy prioritization challenges in communities where the energy grid is at capacity.

This article is divided into five sections. In Section I, I briefly describe the law and geography methodology and discuss it in the context of my data centre research. In Section II, I explore what data centres are and investigate them as infrastructures of cloud computing and as buildings. In this section I also identify five common factors that influence where data centres are built. In Section III, I describe the problem with data centres and underscore their extreme electricity and water demands. Section IV situates the materiality of data centres in a broader social, historical, and technological context. Finally, Section V includes my proposed regulatory response to the problem of data centres prior to my concluding remarks in Section VI.

I. LAW AND GEOGRAPHY AND DATA CENTRES

This article considers data centres in the context of the law and geography methodology. As a result, my analysis is oriented by a "'co-constitutive' approach"[36] which views the legal, social, and spatial as imbricated.[37] In following this approach, "[l]egal geographers note that nearly every aspect of law is located, takes place, is in motion, or has some spatial frame of reference."[38] Because the legal geographer understands "the spatial, the social and the legal [as] . . . braided together to produce sites", [39] a legal geographer's analysis will "identify each of the braids, . . . tease them apart and . . . attempt to identify what work law and spatiality are doing at any particular place and time."[40]

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36 Luke Bennett & Antonia Layard, "Legal Geography: Becoming Spatial Detectives" (2015) 9:7 Geography Compass 406 at 408.

37 *Ibid*.

38 Irus Braverman et al, "Introduction" in Irus Braverman, Nicholas Blomley, & David Delaney, eds, *The Expanding Spaces of Law: A Timely Legal Geography* (Stanford: Stanford University Press, 2014) at 1.

39 See e.g. Bennett & Layard, *supra* note 36 at 409.

40 *Ibid*.

Though legal geography is a contextual approach that acknowledges mutually dependent social, spatial, and legal factors, this methodology applies a geographical lens to these factors, thereby "prioritiz[ing] . . . territory, region, locality, and place".[41] This reflects an understanding of "land as a special place or type of property"[42] where "the most interesting and potent recognitions of reciprocal societal and spatial relations" are sited.[43] Because of this, "in most legal geographic studies, investigation has been 'from the site up', focusing on explicating historical, social and spatial specificity."[44] This article proceeds from this understanding and discusses the data centre site with reference to its spatial, social, technological, and legal contexts.

My discussion also takes cues from law and geography scholarship by "[e]mphasizing the ocular"[45] and so I also analyze data centre "sights". This article foregrounds the physical space[46] that data centres occupy to explore "who and what are being seen by law, and then who and what are rendered invisible in these geolegal sites."[47] As a result, my research has "mine[d] the visual interconnections between law and geography"[48] and considered "embodied physical matters, and the embodied visuality inherent in legal projects".[49] In combination with the ocular, I also consider

41 Jane Holder & Carolyn Harrison, "Connecting Law and Geography" in Jane Holder & Carolyn Harrison, eds, *Law and Geography* (Oxford: Oxford University Press, 2003) at 3.

42 *Ibid* at 8.

43 *Ibid*.

44 Bennett & Layard, *supra* note 36 at 410.

45 *Ibid*. See also Irus Braverman, "Hidden in Plain View: Legal Geography from a Visual Perspective" (2011) 7:2 Law, Culture & the Humanities 173 ("Legal Geography may benefit from a much stronger focus on embodied physical matters, and the embodied visuality inherent in legal projects in particular" at 185).

46 While the methodology does not limit its focus to the physical aspects of space, foregrounding the spatial is an important turn in legal geography. See e.g. Braverman et al, *supra* note 38 at 1–2.

47 Braverman, *supra* note 45 at 174.

48 *Ibid* at 182.

49 *Ibid* at 185.

the materiality of the data centre.[50] Johnson has suggested that a material approach, which "attend[s] to the lived experience of their physical presence—sheds fresh light on digital systems and their impact by shifting focus from their content to the distributions, operations, and affordances of their form."[51] In focusing on the ocular and material, I investigate data centres as infrastructural and technological artifacts.

In the section that follows I will anchor my analysis in the physicality and geographical location of data centres. I do note that in foregrounding the spatial, I must avoid "the pitfalls of spatial fetishism"[52] as, for the legal geographer, "what is always at issue is the *content*, not the spatial form, of the *relations through which, space is constructed*".[53] My analysis will proceed from the earth out, therefore I will first visualize and then situate the data centre.

My research included visits to three data centre sites in the Halifax Regional Municipality.[54] At times I will refer to photographs taken during this field work in this article by

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50 My approach to "materiality" is similar to that taken in Tyler McCrea, *Sensing the Cloud: A Materialist Spatial Analysis of Data Centers and Critical Conceptualization* (Master's Thesis, University of Washington, 2021) [unpublished] ("I will use … [materiality] to mean the materials both isolated and connected that are composed in or through the data center, from the raw materials utilized in building construction, or server creation, along with the land and soil on which the data center is built" at 18).

51 Johnson, *supra* note 19 at 78.

52 Bennett & Layard, *supra* note 36 at 408, citing Chris Butler, "Critical Legal Studies and the Politics of Space" (2009) 18:3 Soc & Leg Studies 313 at 327.

53 *Ibid* at 409, citing Doreen B Massey, *For Space* (London: SAGE, 2005) at 101 [emphasis in original].

54 These sites were chosen because they were listed on a website recommended as a source for locating data centres by Alan Wiig, a geography scholar. See Alan Wiig, "The Urban, Infrastructural Geography of 'The Cloud'" *Vantage* (8 December 2015), online: *Medium* <medium.com/vantage/the-urban-infrastructural-geography-of-the-cloud-1b076cf9b06e>. The website is found at "Halifax Data Centers", online: *Data Center Map* <datacentermap.com/canada/halifax/>. While as of writing there are five Halifax data centre locations listed on this website, I have determined two of these data centres are no longer ongoing concerns.

reference to the attached Annex. This field work reflects my approach in this paper to foreground the spatial and reflect legal geography's "emphasis on the ocular". It also allows me to reflect on how the Halifax data centres that I have observed exemplify information uncovered during my documentary research.

II. DATA CENTRES

During the above-referenced Apple conference, Jobs quipped that an Apple data centre was "a pretty large place . . . full of stuff, full of expensive stuff."[55] This section elaborates on the "place" and "stuff" of data centres. Though Jobs was making a joke by being intentionally vague, to describe a data centre as a mix of place and stuff is apt. Data centres are buildings that occupy physical space, yet within their walls they host elements of digital infrastructure—the "stuff" of cyberspace. This infrastructure is critical to the flow of global data traffic for the information society[56] and "form[s] the backbone of a wide variety of services offered via the Internet including Web-hosting, e-commerce, social networking, and a variety of more general services such as software as a service (SAAS), platform as a service (PAAS), and grid/cloud computing [e.g. infrastructure as a service]."[57] Data centres are critical components in "Information Communications Technology (ICT) infrastructure and work in conjunction with

55 The unofficial AppleKeynotes channel, *supra* note 3 at 00h:37m:55s.

56 Not only are data centres critical to the functioning of the contemporary internet but have also been essential tools that have helped weather the disruptions to business and education caused by the COVID-19 pandemic. See e.g. Peter Judge, "Data Center Staff Classed as 'Essential' during Pandemic" *Data Center Dynamics* (20 March 2020), online: <datacenterdynamics.com/en/news/data-center-staff-classed-essential-during-pandemic/>.

57 Kant, *supra* note 20 at 2939. See also Louise Amoore, "Cloud Geographies: Computing, Data, Sovereignty" (2018) 42:1 Progress in Hum Geography 4 ("the architecture of cloud computing had begun to develop the three components now most recognizable in the cloud: *Infrastructure as a service*, in which hardware, servers, storage, cooling, and energy are supplied; *platform as a service*, in which the software stack is accessed via the cloud; and the *applications layer*, in which data analytics capacity is supplied via the cloud" at 7 [emphasis in original]).

other infrastructures (i.e. fiber optic cables, cellular towers, software, and network protocols) to enable digital communication, data transmission, and storage".[58]

A. TYPES OF DATA CENTRES

Sometimes referred to as "digital warehouses,"[59] "factories of the information age",[60] and "where the internet lives",[61] data centres can have many functions and support different business models. Data centres are often characterized as either "enterprise data centres", which are owned by companies that operate their own equipment on their own premises, or "colocation data centres" where the ownership of these components is split.[62] In a colocation model, a provider "hosts the infrastructure: building, cooling, bandwidth, security, etc., while the company provides and manages the components, including servers, storage, and firewalls."[63] The industry leaders in the colocation business model are corporately organized as real estate investment trusts (e.g. Equinix) which means that the majority of (1) their assets are real estate and (2) their income is rent collected from real property (i.e. not services or personal property).[64]

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58 McCrea, *supra* note 50 at 11.

59 James Glanz, "Power, Pollution and the Internet", *The New York Times* (22 September 2012), online: <nytimes.com/2012/09/23/technology/data-centers-waste-vast-amounts-of-energy-belying-industry-image.html> [Glanz, "Power, Pollution and the Internet"].

60 Gary Cook & Elizabeth Jardim, "Clicking Clean Virginia: The Dirty Energy Powering Data Center Alley" *Greenpeace* (2019) at 3, online (pdf): <greenpeace.org/usa/reports/click-clean-virginia/>.

61 Holt & Vonderau, *supra* note 21 at 71.

62 "Understanding Different Types of Data Center" (11 May 2020), online: *AFL Hyperscale* <aflhyperscale.com/articles/techsplainers/understanding-different-types-of-data-center> (provides detailed categorizations of data centres).

63 "What is a Data Center" (Accessed 14 December 2021), online: *Cisco* <cisco.com/c/en_ca/solutions/data-center-virtualization/what-is-a-data-center.html#~types-of-data-centers>.

64 See Greene, *supra* note 30.

Data centres are also used to support service-based business models wherein the user licenses the use of equipment (to store data, run software, etc.) on a pay-as-you-go basis. This hosting model[65] could be supported by (1) equipment in an enterprise centre, (2) equipment in a colocation data centre, or (3) a mixture of both.[66] All three of the data centres I visited offer colocation solutions while the Liberated Software Data Centre (Annex VI) and Bell Aliant Data Centre (Annex II-V) also offer hosting services.[67]

Data centres can also be differentiated based on their relative focus on data storage or networking.[68] Colocation data centres not only rent space for equipment but also provide the opportunity for direct peering connections between clients.[69] As a result, this business model benefits from network effects, as the more clients a colocation data centre has, the more valuable its space becomes. This effect can be further strengthened if a colocation data centre hosts the equipment of an influential company in the digital economy (e.g. Amazon). Equinix calls such clients "magnet customers", and they are akin to "department store 'anchor tenants' that draw foot traffic to malls."[70]

Data centres can range in size from a small closet to a massive warehouse and take many forms. For instance, the Liberated Software Data Centre in Annex VI looks like a residential structure. The largest data centres however, are hyperscale data centres. These are run by the Big Tech companies like Google and are

65 See Benjamin K Sovacool, Paul Upham & Chukwuka G Monyei, "The 'Whole Systems' Energy Sustainability of Digitalization: Humanizing the Community Risks and Benefits of Nordic Datacenter Development" (2022) 88 Energy Research & Social Science (where "the owner rents both the infrastructure and the IT equipment to host information servers, etc." at 3).

66 See Greene, *supra* note 30 (the tech giants, though they have their own infrastructure that supports the provision of cloud services, still rely on leasing additional capacity from colocation providers in a "largely symbiotic" relationship at 919).

67 For the profiles of each data centre, see "Explore The Leading Global Data Center Database!", online: *Data Center Map* <datacentermap.com>.

68 See e.g. Greene, *supra* note 30 at 908–09.

69 See *ibid* at 908.

70 *Ibid*.

titanic in size.[71] For instance, Google operates a 300-acre data centre complex in Iowa which could accommodate about "235 American football fields."[72] The size of this type of data centre is a byproduct of the data driven business models of Big Tech. A hyperscale data centre can support both a company's own data intensive products (e.g. Google Search), as well as providing cloud services to its users (e.g. Gmail).[73] While hyperscale data centres are the largest in size, in terms of total square footage, more data centre space is owned by the "landlords of the internet", the real estate investment trusts that own colocation space.[74]

No matter what they are called, or whether they generate revenue from services or space, data centres are material structures. They are facilities, located on real property, that contain computer equipment. This said, they are also critical components in global communications infrastructure and cloud computing. Each of these aspects influences the operation of equipment and location of facilities.

I. DATA CENTRES AS INFRASTRUCTURE

Similar to other critical infrastructure, service interruptions to data centres can trigger immediate and widespread effects.[75] Because of this, data centre operators try to avoid downtime at all costs[76] and will install redundant[77] connections to both

71 See *AFL Hyperscale, supra* note 62.

72 Google Cloud Tech, "An Insider's Look: Google's Data Centers (Cloud Next '19)" (11 April 2019) at 00h:12m:08s, online (video): *YouTube* <youtu.be/yfF3pOzdmlE>.

73 See e.g. Greene, *supra* note 30 ("[e]nterprise firms like Amazon and Microsoft build for themselves, and for the cloud infrastructure they provide to businesses" at 918).

74 *Ibid* at 919.

75 See e.g. "Swaths of the Internet Go Down After Cloud Outage", *NPR* (8 June 2021), online: <npr.org/2021/06/08/1004305569/internet-fastly-outage-go-down-twitter-reddit> (After a number of large websites went down due to "an outage at the cloud service company Fastly" in June, 2021, "all major futures markets in the U.S. dipped sharply minutes after the outage").

76 See e.g. Lamia Youssef, Maria Butrico & Dilma Da Silva, "Toward a Unified Ontology of Cloud Computing" presented at *IEEE 2008 Grid Computing*

telecommunications and power infrastructure.[78] Redundant connections also permit data centre operators to perform necessary hardware replacement and software updates without any downtime.[79] So important is redundancy that the industry certification system classifies data centres into four tiers which reflect the varying levels of redundancies embedded in the data centre and the associated shutdown risks.[80]

In addition to network redundancy, data centres will also duplicate data stored on their systems by "geo-replicating or 'mirroring' data in multiple locations . . . [thus providing] greater redundancy against local-level outages (due to fires, flooding, power loss, system failure, security breaches, etc.)."[81] This practice requires backup servers to "idl[e] in a state of always-on readiness",[82] ready to spring into action in case the primary servers fail.

The redundant design of data centres ensures that failure is never noticed at the service level. Because the end user will rarely notice the failure of this technology, they are not often confronted

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Environments Workshop (2008) ("high availability is one of the fundamental design features of every cloud offering" at 2).

77 Redundancies in internet infrastructure reduce the risk that a small actor or isolated event disrupts the entire network. See e.g. Tom Parfitt, "Georgian woman cuts off web access to whole of Armenia", *The Guardian* (6 April 2011), online: <theguardian.com/world/2011/apr/06/georgian-woman-cuts-web-access>.

78 See Jacobson & Hogan, *supra* note 12 at 82 (Data centres are typically "powered from multiple local utilities, diesel generators, battery banks, and cooling systems" at 82).

79 See Google Cloud Tech, *supra* note 72 ("we have to do maintenance and we have to do upgrades and repairs while the data centre is still live. So we build in the ability to, one, make it fault tolerant, and two, make it concurrently maintainable" at 00h:14m:20s).

80 See "Tier Certification" (Accessed 29 April 2022), online: *Uptime Institute* <uptimeinstitute.com/tiers>.

81 Taylor, "Failover Architectures", *supra* note 14.

82 *Ibid*.

with the reality of mechanical breakdown and labor that is part of the normal operation of cloud computing.[83]

Entwined with the priority of uptime is the "end-user expectation of anything, anytime, anywhere".[84] This expectation incentivizes data centres to strive for instantaneous data delivery requiring "facilities [to] operate at their full capacity at all time[s], regardless of the actual demand, which means that an incredible amount of energy is reserved for idling."[85]

Brian Larkin observes that when it comes to visibility of infrastructure, it is important to "examine how (in)visibility is mobilized and why."[86] Their redundant systems and uptime commitment make data centres invisible by design. Because breakdown is hidden at the data centre, this infrastructure recedes from view.[87] In its place, the cloud appears, an image that conveys the mobility of digital data.

II. Data Centres and Clouds

Like a cloud, data centres can be quite nimble and drift to many locations. For example, Microsoft's Project Natick is researching a data centre design which would be the size of a shipping container,

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83 See e.g. Taylor, "Standing By for Data Loss", *supra* note 15 ("[t]he cloud is a key service through which the anticipated disaster of device failure is transformed from a shocking or rupturing event into a forgettable, permissible and (relatively) non-disruptive event" at 65–66). See also ARE Taylor, "Cloudwork: Data Centre Labour and the Maintenance of Media Infrastructure" in Elisabetta Costa et al, eds, *The Routledge Companion to Media Anthropology* (London: Routledge, 2023) at 215.

84 Glanz, "Power, Pollution and the Internet", *supra* note 59 quoting David Cappuccio.

85 Hogan, "Facebook Data Storage", *supra* note 27 at 6.

86 Brian Larkin, "The Politics and Poetics of Infrastructure" (2013) 42:3 Annual Rev Anthropology 327 at 336.

87 This is a reflection of "Star's (1999) assertion that infrastructures are 'by definition invisible,' taken for granted, and that they only 'become visible on breakdown'": *ibid* at 336, citing SL Star, "The Ethnography of Infrastructure" (1999) 43:3 American Behavioral Scientist 377 at 380. Larkin calls this observation a "partial truth" as sometimes infrastructure is purposely ostentatious, or by reason of inequality visible for some and not others.

can be submerged in water, and deployed within 90 days.[88] This mobility is related to an important affordance of data centres which is the "export of computational work."[89]

Data centres are a fundamental component of remote, cloud computing and provide consumers and businesses the ability to outsource the processing, storage, and transmission of digital information. This has caused the "liberat[ion]" of "data and programs . . . as they are 'swept up from desktop PCs and corporate servers and installed in the compute cloud'".[90]

The cloud computing paradigm is conditional on data centre infrastructure[91] which enables "scalable computing, where the client pays for what they have used, combined with distributed computing, where multiple concurrent users can share and combine their data and their analyses."[92] Because computational work can be exported and imported across vast distances, data centres do not have to be near the people that rely on them. Despite this flexibility, "[data centres] are not randomly dispersed

88 "Facts and Figures" (Accessed 20 January 2023), online: *Project Natick* <natick.research.microsoft.com>.

89 Amoore, *supra* note 57 at 7, citing Youssef, Butrico & Da Silva, *supra* note 76.

90 Amoore, *supra* note 57 at 7, citing Brian Hayes, "Cloud Computing" (2008) 51:7 Communications of the ACM 9 at 9. This is a paradigmatic shift, see e.g. Michael Armbrust et al, "Above the Clouds: A Berkeley View of Cloud Computing" (10 February 2009), online (pdf): *Electrical Engineering and Computer Sciences University of California at Berkeley* <eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf> ("[d]evelopers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. . . . This elasticity of resources, without paying a premium for large scale, is unprecedented in the history of IT" at 1).

91 As well as other advances in digital technology including "virtualization, which in effect allows servers to merge their identities into large, flexible computing resources that can be doled out as needed to users, wherever they are": Glanz, "Power, Pollution and the Internet", *supra* note 59.

92 Amoore, *supra* note 57 at 7. See also Armbrust et al, *supra* note 90 ("We argue that the construction and operation of extremely large-scale, commodity-computer datacenters at low cost locations was the key necessary enabler of Cloud Computing" at 1).

across space."[93] In the next section I will discuss the factors that influence their deployment.

B. Locating Data Centres

In a YouTube video on the "Google Cloud Tech" channel, Joe Kava reflects on how Google selects their data centre locations, stating that

> a lot of people always ask me, "how do you choose a data centre site?" And if I were to quote the head of our site selection team, he would probably say, it's more or less the art of compromise—because there is no one site that meets 100% of every single thing we would love, so we try and find the best compromise.[94]

This compromise, or what Ingrid Burrington calls "a carefully calibrated form of real estate alchemy,"[95] is an open formula that involves many variables.[96] Though it may be difficult to identify all of the relevant braids present at a data centre site, the following five are commonly present: (1) supply of power and water, (2) land and climate, (3) distance to network and customers, (4) regulatory environment, and (5) security. These factors are not discrete values and are folded into each other. I will expand on each of these factors below and discuss how each factor influences the placement of data centres.

I. Factor 1: Supply of Power and Water

Perhaps the "key consideration"[97] in the selection of a data centre location is whether a proposed site has reliable access to a supply of power and water. Significant amounts of electricity are

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93 Constance Carr, Desmond Bast, Karinne Madron, and Ahmad Mafaz Syrus "Mapping the Clouds: The Matter of Data Centers" (2022) 18:1 Journal of Maps 106 at 108.

94 Google Cloud Tech, *supra* note 72 at 00h:11m:04s.

95 Ingrid Burrington, "Why Are There So Many Data Centers in Iowa?", *The Atlantic* (1 December 2015), online: <theatlantic.com/technology/archive/2015/12/why-are-so-many-data-centers-built-in-iowa/418005>.

96 Burrington suggests there may be as many as forty. *Ibid*.

97 Jaeger et al, *supra* note 20 at 6.

necessary to both operate the machines in data centres and disperse the heat they generate. According to the International Energy Association (IEA), "[g]lobal data centre electricity use in 2021 was 220–320 TWh, or around 0.9%–1.3% of global final electricity demand. This excludes energy used for cryptocurrency mining, which was 100–140 TWh in 2021."[98] On a global scale this number might not seem like a lot; however, when you consider specific data centres and local electricity capacity, the amount of electricity required by this sector is brought starkly into focus. For example, in 2008 it was reported that a Microsoft data centre in Chicago required "three electrical substations to fuel its constant need for 200 megawatts of power."[99] Allocating this amount of electricity is no easy task. For scale, 200 megawatts would account for half of the hydroelectric power generated by Nova Scotia Power.[100]

Data centres also "consume water across two main categories: indirectly through electricity generation (traditionally thermoelectric power) and directly through cooling."[101] Similar to electricity use, data centre water use might seem low when assessed at a large scale. For instance, the per day water consumption in the US attributed to data centres is 1.7 billion litres/day, whereas total national use is 1218 billion litres/day.[102] This said, at a local level a data centre can demand a large share of local resources. For example, a "medium-sized data centre (15

98 "Data Centres and Data Transmission Networks" (Accessed 30 January 2023), online: *IEA* <web.archive.org/web/20230130042049/iea.org/reports/data-centres-and-data-transmission-networks>.

99 Jaeger et al, *supra* note 20 at 6.

100 "Provincial and Territorial Energy Profiles—Nova Scotia" (Accessed 30 January 2023), online: *Canada Energy Regulator* <cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-nova-scotia.html#:~:text=Nova%20Scotia%20has%20an%20estimated,hydro%2C%20wind%2C%20and%20biomass> ("Nova Scotia Power operates 33 hydroelectric plants on 17 hydro river systems across Nova Scotia, totaling 400 MW of generation capacity").

101 Mytton, *supra* note 28 at 1.

102 *Ibid.*

megawatts (MW)) uses as much water as three average-sized hospitals, or more than two 18-hole golf courses."[103]

Not only is access to resources important, so too is their cost. The cost of electricity is not uniform across jurisdictions; therefore, locating data centres in municipalities that have sources of cheap power allow data centres to benefit from a type of digital arbitrage. Data centres take advantage of the insight that "[p]hysics tells us it's easier to ship photons than electrons; that is, it's cheaper to ship data over fiber optic cables than to ship electricity over high-voltage transmission lines."[104] Therefore, the data centre sector is a "footloose industry" and can chase low electricity rates without suffering unacceptable information loss.[105] This practice of photon/electron arbitrage means that data centres can crop up in unexpected places.[106] Cheap electricity is one of the reasons that Northern Virginia, the site of "Data Center Alley",[107] has had so much growth in this industry and low prices

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103 *Ibid.*

104 Armbrust et al, *supra* note 90 at 6.

105 Not unlike the power-stations that undergird their operation: see e.g. Artur Glikson, *The Ecological Basis of Planning,* ed by Lewis Mumford (The Hague, Netherlands: Martinus Nijhoff, 1971) ("power-stations are becoming a footloose industry, which can be set up anywhere, since they can exist virtually without fuel shipments" at 91). This aspect is reflected in the development of portable, modular data centres: see e.g. Max Smolaks, "Compass Datacenters Launches White Space-as-a-Service" (5 April 2022), online: *Data Center Knowledge* <datacenterknowledge.com/colocation/compass-datacenters-launches-white-space-service>.

106 See e.g. Jacob Barker, "'It's the New Emerging Thing': Mining for Data in Western Labrador", *CBC* (26 July 2016), online: <cbc.ca/news/canada/newfoundland-labrador/data-storage-bitcoins-western-labrador-1.3694238> (of note is that the cryptocurrency mining data centre functions like a processing plant rather than distribution centre and so the data transmission capacity is less important than access to cheap, reliable energy).

107 Cook & Jardim, *supra* note 60 at 7. See also Canada Energy Regulator, "Market Snapshot: Data Centres Show Interest in Operating in Labrador" (13 February 2019), online: *Government of Canada* <cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2019/market-snapshot-data-centres-show-interest-in-operating-in-labrador.html> ("[o]ne of the main reasons for this emerging demand is that Labrador has one of the lowest electricity rates in North America").

are used by municipalities as a draw to encourage data centre development.[108] The source of electricity is also an important consideration because many industry leaders have pledged to run their facilities on renewable energy.[109] Like cost, the availability of renewable energy can vary greatly between jurisdictions and so despite these pledges, the availability of renewable energy for a proposed data centre development may at times be more of a garnish than necessary condition.[110]

II. FACTOR 2: LAND AND CLIMATE

Since data centres are buildings situated on real property, it is no great surprise that a data centre requires "suitable physical space in which to construct the [often] warehouse-sized buildings".[111] In the case of hyperscale data centres, this requires a significant amount of land; therefore, hyperscale developments are often located in rural areas and industrial parks. For these developments, the less neighbors the better as these developments occupy a large footprint and may want to expand.

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108 See e.g. City of Prince George, *Data Centres* (Accessed 12 December 2021), online (pdf): <web.archive.org/web/20191021095726/www.princegeorge.ca/Business%20and%20Development/Economic%20Development%20Documents/Data%20Centre%20Mini%20Booklet.PDF> ("BC Hydro offers competitive rates that are among the lowest in North America, helping to keep operating costs low" at 7).

109 See e.g. "China's Tencent Unveils Goal to Run on 100% Green Energy by 2030" (25 February 2022), online: *Data Center Knowledge* <datacenterknowledge.com/cloud/china-s-tencent-unveils-goal-run-100-green-energy-2030>; Irina Ivanova, "Facebook Reaches 100% Renewable-Energy Milestone", *CBS News* (15 April 2021), online: <cbsnews.com/news/facebook-renewable-energy-commitment-100-percent-milestone>.

110 As suggested by Google's Joe Kava's comment that "if you can wrap . . . [your reliable, high performance data centre] with a bow of sustainability, then you've got something that is truly meeting all your needs": Google Cloud Tech, *supra* note 72 at 00h:02m:06s. See also "Google, Facebook Stoke Wind-Farm Debate" (11 June 2022), online: *Data Center Knowledge* <datacenterknowledge.com/sustainability/google-facebook-stoke-wind-farm-debate>.

111 Jaeger et al, *supra* note 20 at 5.

The Eastlink Pennant Point Data Centre (the "Eastlink Data Centre") shown in Annex I is an example of a rural site.[112]

In some cases, data centres will be built on lots with suitable pre-existing buildings. In these cases, data centres move in like a hermit crab, making their home in buildings left vacant by long lost heavy industry and military tenants.[113] For these sites, the economic history of the region is imbricated with the material site. The Bell Aliant Data Centre in Annex II-V is an example of a site with a lengthy history of using different telecommunications technologies, a history etched into its patchwork and additive aesthetic.[114]

Included within this factor are associated climate considerations. A prospective data centre operator will analyze levels of risk from natural disasters like earthquakes and hurricanes (and associated power blackouts) that could interrupt service. An important climate feature is whether the location includes "energy-saving natural features" which could include access to cold water or air for cooling equipment.[115]

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112 See also the Northern Virginia sites described in: Burrington, "The Cloud Is Not the Territory", *supra* note 26; each of the twelve potential sites identified by the city of Prince George, British Columbia in their promotional brochure intended to attract data centre businesses to invest in their region: *supra* note 108 at 10–21.

113 See e.g. Furlong, "Geographies of Infrastructure II", *supra* note 25 ("[d]ata centres have repurposed the industrial and military infrastructures of the 20th century, connecting 'our digital present to our industrial past'" at 191).

114 See also Johnson, *supra* note 19 (the Arctera data centre in Iceland is located on a former American military base); Pickren, "The Factories of the Past are Turning Into the Data Centers of the Future", *supra* note 10 (data centres in the former R.R. Donnelley & Sons printing factory and Shulze Baking Company buildings in Chicago); Dan Winhoe, "Microsoft Planning Toronto Data Center on Site of Closed Lowe's Store" (22 March 2022), online: *Data Center Dynamics* <datacenterdynamics.com/en/news/ microsoft-planning-toronto-data-center-on-site-of-closed-lowes-store>.

115 Jaeger et al, *supra* note 20 at 5.

III. FACTOR 3: DISTANCE TO EXISTING INFORMATION NETWORK INFRASTRUCTURE AND CUSTOMERS

Because data centres are components of internet infrastructure, they must be able to physically connect to other sections of internet infrastructure. As Jaeger et al write, "it is desirable to place data centres close to the 'Internet backbone' or the main 'trunks' of network that carry most of its traffic".[116] While data centres do not have to be adjacent to these main trunks (a wired connection will suffice), the closer a data centre is to a main connection, the quicker data can be transmitted across the network. Therefore, data centres that are close to main trunks can be both data processing plants and distribution centres.

Depending on the user and application, distance (and thus latency) may be more or less important. For instance, in the use case of "high frequency trading", a type of stock trading that "relies upon algorithms to buy and sell stocks in millionths of a second, the proximity of a hedge fund server to a stock exchange server can be worth millions of dollars".[117]

This factor will sometimes result in the clustering of data centres in the same area, as connection begets connection. For example, one reason why Northern Virginia is the home of so many data centres is that the region is also where the largest concentration of Amazon Web Services infrastructure resides. Because Amazon is such an important player in this space, its infrastructure creates "a gravitational effect on other major data center operators".[118] This network effect at the deployment level parallels the networks effects at the client level as discussed in Section II-A.

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116 *Ibid* at 6.

117 Pickren, "The Global Assemblage of Digital Flow", *supra* note 24 at 231.

118 Cook & Jardim, *supra* note 60 at 7 (it is perhaps unsurprising that Amazon can diminish this type of "last mile" problem by leveraging its market power. Though it is outside the scope of this paper, it is possible that competition law enforcement in this industry may alleviate some of the problems it presents).

IV. FACTOR 4: LEGAL AND REGULATORY ENVIRONMENT

An incredibly influential regulatory factor with respect to data centres is the presence or absence of favorable tax rates. Like energy prices, this factor alone can be quite enticing, drawing data centres to a jurisdiction like moths to a flame. For example, this factor has resulted in an explosion of the data centre industry in Ireland to the extent that data centres are expected to "use almost 30 per cent of Ireland's electricity by 2028".[119] One of the major reasons that so many data centres have clustered there is the "attractiveness of the country's tax climate—its 12.5% corporate tax rate is the lowest in the 'industrialized' world".[120] Similar to corporate tax rates, governments will sometimes extend tax subsidies to data centre operators in order to incentivize development.[121] Tax laws that affect corporate organizational structure (i.e. laws related to real investment trusts) also have an influence on this industry.[122]

Internet governance laws, such as privacy, data protection, and data sovereignty laws, can also be relevant to data centre placement. Local laws that either strengthen or weaken control over and access to data can affect the placement of internet infrastructure. For example, in November 2021, it was announced that the "first submarine cable between Europe and South America" had gone live.[123] This 2014 project was initiated in the

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119 Marietje Shaake, "Europe Needs to Wake Up to the Costs of Hosting Massive Data Centres", *Financial Times* (7 December 2021), online: <ft.com/content/fe968bbb-c15d-455f-964c-9aeeef9db5f1>.

120 Brodie, *supra* note 29 at 1105–06.

121 See e.g. Sharon Fisher, "Report: Data Centers in Virginia Supported $17 Billion in Economic Output in 2021" (28 March 2022), online: *Data Center Knowledge* <datacenterknowledge.com/colocation/report-data-centers-virginia-supported-17-billion-economic-output-2021>, ("[t]oday, more than 30 states offer some sort of incentive program to attract data centers"); Sharon Fisher, "Meta To Build First Data Center in Idaho" (21 February 2022) online: *Data Center Knowledge* <datacenterknowledge.com/facebook/meta-build-first-data-center-idaho>.

122 See Greene, *supra* note 30.

123 Max Smolaks, "First Submarine Cable Between Europe and South America Goes Live" (25 November 2021), online: *Data Center Knowledge*

wake of Edward Snowden's revelations of extensive American digital communications surveillance and was framed as a way of establishing a direct data link with Europe that did not have to travel through the US.[124] This concern for control is also reflected in the Government of Canada's 2017 "IT Policy Implementation Notice" which requires that certain categories of information be stored in a data centre "within the geographic boundaries of Canada".[125] Iceland explored data protection as a business development opportunity by considering laws that extend protections to data stored on data centres within its borders.[126] As opposed to attracting business by being a "tax haven" such laws would attract business by creating a "data haven".[127]

Land use and zoning laws can also influence data centre development by regulating the data centre building and use of land. Land use laws are potentially powerful sources of data centre

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<datacenterknowledge.com/networks/first-submarine-cable-between-europe-and-south-america-goes-live>.

124 *Ibid* ("'We have to respect privacy, human rights and the sovereignty of nations. We don't want businesses to be spied upon,' Dilma Rousseff, then president of Brazil, said when she announced the cable in 2014").

125 Treasury Board of Canada Secretariat, "IT Policy Implementation Notice" (1 November 2017) online: *Government of Canada* <canada.ca/en/government/system/digital-government/digital-government-innovations/cloud-services/direction-electronic-data-residency.html>. See also Treasury Board of Canada Secretariat, "Government of Canada Strategic Plan for Information Management and Information Technology 2017 to 2021" (2017), online: *Government of Canada* <canada.ca/en/treasury-board-secretariat/services/information-technology/strategic-plan-2017-2021.html>.

126 See e.g. "Iceland to become International Transparency Haven" (Accessed 15 December 2021), online: *International Modern Media Institute* <https://en.immi.is/immi-resolution> ("[t]he Icelandic Modern Media Initiative is based on turning the tax-haven concept on its head. Instead of pulling together asset hiding and secrecy laws from around the world in order to shelter corruption and financial crime, the IMMI pulls together the best transparency enabling legislation, to create a stronghold for investigative journalists, internet publishers, transparency watchdogs and the public").

127 Reminiscent of "Sealand", the ancestral tech "platform": see e.g. Thomas Stackpole, "The World's Most Notorious Micronation Has the Secret to Protecting Your Data From the NSA" (21 August 2013), online: *Mother Jones* <motherjones.com/politics/2013/08/sealand-havenco-data-haven-pirate>.

regulation as a data centre must use and occupy real property. The drafting and enforcement of land use and zoning laws are typically delegated to municipalities and as such, they can exhibit a high level of diversity. With proper procedural safeguards at the local level, citizens can have meaningful participation in the construction of this infrastructure, despite its global sprawl. As Julia Rone writes, "the process of regulating infrastructure is bound to local debates about scarce resources in the context of the global sustainability transition."[128] The outcomes of these debates and their local contours can be expressed through land use law. Though Canadian municipal bylaws do sometimes consider data centres as specific uses of land, land use laws present a permissive rather than restrictive influence on the spatiality of data centres.

V. FACTOR 5: SECURITY

Security is an ever-present concern for data centre operators and often dictates the design of data centre buildings and site selection. This concern will often mean that the ideal location for a data centre is "an area that is low in crime, far from likely terrorist targets, and easy to guard against corporate espionage".[129] Data centres are often (though not always)[130] set behind a secure perimeter such as seen at the Eastlink Data Centre in Annex I. The presence or absence of a secure perimeter can be an important feature that motivates site selection.[131] Furthermore, the locations of data centres are not usually disclosed in the name of security.

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128 Julia Rone, "The Shape of the Cloud: Contesting Date Centre Construction in North Holland" (2023) 0:0 New Media & Society 1 at 15.

129 Jaeger et al, *supra* note 20 at 5.

130 See e.g. Burrington, "The Cloud is Not the Territory", *supra* note 26 ("[s]ome are very open, allowing clients to tour the facilities, while others are much more secretive, citing security concerns, and don't even provide public addresses").

131 See e.g. *Bastionhost Ltd v Colchester Regional Development Agency*, 2007 NSSC 334 (where a secure perimeter was a condition of sale of a property for the purposes of data centre development, "counsel for the applicant stated that the 'closed system' was essential for the operation of the applicant's business" at para 21).

For instance, in the terms of use for Microsoft Office 365, Microsoft notes that they do "not disclose the exact addresses of [their] data centers. [They] established this policy to help secure [their] data center facilities."[132] The reason I was able to identify the three data centres in Halifax for my infrastructure walk is because they have a public presence; however, there are other data centres in Halifax that are not as easily identifiable. For example, Eastlink has built a new 13,000 square foot facility but it is hard to locate because "for security reasons, the company isn't revealing the exact location of the centre, other than that it is located within the [Halifax Regional Municipality]."[133]

For some data centre operators, security, rather than convenience, is the main thrust of their offering.[134] These data centres might be set up in former military bunkers[135] and tout not only their digital security measures, but their physical security as well. Such bunkered data centres may offer a security force of former military and police personnel and promise resilience to all manner of attack including electromagnetic pulses and nuclear explosions.[136] Interestingly, as Taylor has observed, bunkered data centre operators would prefer to emphasize their "stone" rather than "cloud" nature. As one data centre managing director said to

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132 "Overview and Definitions" (3 December 2021), online: *Microsoft* <learn.microsoft.com/en-ca/microsoft-365/enterprise/m365-dr-overview?view=o365-worldwide>.

133 Derek Montague, "Eastlink Spending $20-Million On Halifax Facility" (2 March 2022), online: *Huddle* <huddle.today/2022/03/02/eastlink-spending-20-million-on-halifax-facility>.

134 This branding depends on the values of the target client. A financial institution would typically value data security, resilience, and permanence above convenience.

135 See e.g. Jason Malloy, "Diefenbunker turned data centre", *Saltwire* (30 September 2017), online: <saltwire.com/atlantic-canada/federal-election/diefenbunker-turned-data-centre-150845/>; Robert McMillan, "Deep Inside the James Bond Villain Lair That Actually Exists" *Wired* (21 November 2012), online: <wired.com/2012/11/bahnhof/>; Taylor, "Future-Proof", *supra* note 32.

136 See e.g. Taylor, "Future-Proof", *supra* note 32.

Taylor, "[i]f people think their data's just stored in some make-believe cloud, this is bad for our business".[137]

III. THE PROBLEM WITH DATA CENTRES

In *Empire and Communications*, Harold Innis wrote that "Pirenne has commented on the irony of history in which as a result of the character of the material much is preserved when little is written and little is preserved when much is written."[138] In other words, an engraved stone tablet has an easier chance of standing the test of time than a paperback book. Data centres are seemingly an exception to this irony. They strive to be a stone-like medium, permanent and sturdy, yet also capable of recording a glut of information. Their resilience, however, does not come from the inherent properties of digital media but from an ongoing commitment to acquire and consume enough resources to ensure that mountains of data can stand on their own, as if made of stone.[139]

The problem with data centres that I focus on in this paper is rooted in their need for great amounts of electricity and water. Data centres constantly consume electricity to both operate equipment and counteract the waste heat generated by such operation. Though they can draw tremendous amounts of electricity, "there remains considerable uncertainty about total data centre energy consumption."[140] As mentioned above, the IEA estimated global data centre electricity use for 2021 at 220–320 TWh (with an additional 100–140 TWh attributable to cryptocurrency mining). Other "[e]stimates for 2018 range from 200 to 500 TWh".[141] Unfortunately, estimates can vary greatly and

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137 See e.g. *ibid* at 91.

138 Harold A Innis, *Empire and Communications* (Toronto: University of Toronto Press, 2022) at 9.

139 Tung-Hui Hu calls this a "fantasy of indefinite preservation": Tung-Hui Hu, "Black Boxes and Green Lights: Media, Infrastructure, and the Future At Any Cost" (2017) 55:1–2 English Language Notes 81 at 85 [Hu, "Black Boxes and Green Lights"].

140 Mytton, *supra* note 28 at 1.

141 *Ibid*. See also *IEA*, *supra* note 98.

become quickly outdated.[142] Further complicating such analysis are "pervasive data gaps . . . [which mostly] result from reluctance among tech companies to share the latest proprietary information."[143] Al Kez et al likewise observe that "reliable information on the extent of energy consumption, and underlying emissions, behind data centre infrastructure, remains fragmented, difficult to acquire, and even more difficult to authenticate."[144]

Though data centres can require large amounts of electricity they can be both highly efficient and exclusively use renewable energy. There are many examples of creative data centre designs that reduce power consumption by using the affordances of the natural environment to cool equipment.[145] Large technology companies will also sometimes partner with local energy providers to build new renewable energy projects so that their data centres can run on 100% renewable energy.[146] In addition to

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142 Reasons include the rapid pace of technological change and data traffic growth; another complicating factor is that energy demand is not proportional to data traffic: see e.g. Jonathan Koomey & Eric Masanet, "Does Not Compute: Avoiding Pitfalls Assessing the Internet's Energy and Carbon Impacts" (2021) 5:7 Joule 1625 at 1626–27.

143 *Ibid* at 1627.

144 Dlzar Al Kez et al, "Exploring the Sustainability Challenges Facing Digitalization and Internet Data Centers" (2022) 371:133633 J Cleaner Production at 2.

145 See e.g. Google Cloud Tech, *supra* note 72 at 00h:07m:00s ("[i]n Finland, we bought a paper mill, turned it into a big data centre campus, and it actually was sitting right on the Gulf of Finland. So we were looking at that water that was about 14 degrees Celsius all year round and said, we can use that. So that data centre is 100% cooled by seawater").

146 See e.g. Tennessee Valley Authority, "TVA Announces Largest Valley Solar Installations – Built for Facebook" (2 November 2018) online: *Tennessee Valley Authority* <tva.com/newsroom/press-releases/tva-announces-largest-valley-solar-installations-built-for-facebook>; Burrington, "Why Are There So Many Data Centers In Iowa?", *supra* note 95 ("[Google and Facebook] both worked with MidAmerican Energy to ensure that their data centers would be entirely wind-powered, effectively underwriting the cost of the construction of brand-new wind farms"); "Facebook Data Centers" (Accessed 12 December 2021), online: *Facebook* <datacenters.fb.com> ("Facebook data centers have achieved net zero carbon emissions, are LEED Gold level certified and are supported by 100% renewable energy").

efficient design of the data centre, advances in the efficiency of computing technology, in particular "processor-efficiency improvements and reductions in idle power",[147] have reduced "electricity use per computation".[148]

That said, the data centre industry is not exactly green and the hundreds of TWh being drawn by this industry are not always sourced from renewable energy. For instance, the proliferation of data centres in "Virginia's Data Center Alley continues to fuel and increase demand in coal and natural gas"[149] because "power generation in Virginia is dominated by fossil fuels".[150] Even if the regular operations of a data centre runs on 100% renewable energy, data centres will typically have redundant, backup power sources. Data centre sites are often furnished with standby gasoline and diesel power generators.[151] Although these generators are not typically relied upon in day-to-day operations,[152] they need to be periodically tested, thus consuming fossil fuel and expelling pollutants.[153] Furthermore, as Mél Hogan writes, "no matter how green data centers become, and no matter how innovative renewable energy is, there is a large media ecosystem undergirding it—a world of limited natural resources, techno-trash, toxic bodies, and e-waste".[154]

Not only do data centres consume large amounts of power, they can be extremely thirsty enterprises and use millions of gallons of water a day to dissipate heat generated by their computer

147 Masanet et al, *supra* note 28 at 984.

148 *Ibid*.

149 Cook & Jardim, *supra* note 60 at 3.

150 *Ibid.*

151 See e.g. Glanz, "Power, Pollution and the Internet", *supra* note 59.

152 Their use, however, can sometimes be questionably high. See e.g. James Glanz, "Data Barns in a Farm Town, Gobbling Power and Flexing Muscle", *The New York Times* (23 September 2012), online: <nytimes.com/2012/09/24/technology/ data-centers-in-rural-washington-state-gobble-power.html> [Glanz, "Data Barns"].

153 See e.g. Hogan, "Facebook Data Storage", *supra* note 27 at 12.

154 Hogan, "Big Data Ecologies" *supra* note 26 at 647.

equipment.[155] To put the water use of a data centre in perspective, "a Google data center currently under construction in Mesa[, Arizona,] . . . will use the same amount of water on a daily basis as 9,200 homes."[156] That water may be circulated a number of times within a data centre's liquid cooling system, which then is treated as wastewater and sent back to a municipality's treatment centre.[157] However, treated water has been reported to be "too clean to run through the city's industrial wastewater treatment plant."[158] In this case, the water had been so refined that it was missing bacteria that the wastewater treatment system relied on for its proper operation.[159]

Like information relating to electricity, information regarding water treatment also suffers from gaps. For example, data centres might resist access to their facilities by local water utilities and other regulators wishing to assess the chemical additives used to cool down water by claiming that such information is the subject of trade secrets, as has happened in North Holland.[160]

As I will discuss further below, two aspects of the data centre industry complicate this problem of extreme and dynamic resource demand. First, the materiality of the data centre and its energy consumption demands are obscured by the cloud metaphor. Second, the data centre as a technological artifact is imbued with a politics of extraction. As Allison Carruth writes, when we consider the "problems of life on the Net" we often focus on "the social anomie and habits of mind that digital culture

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155 See e.g. Hogan, "Data Flows and Water Woes", *supra* note 26 at 3; Cameron Polom, "Data Centers Consume Millions of Gallons of Arizona Water Daily", *ABC 15 Arizona* (last modified 12 July 2021), online: <abc15.com/weather/impact-earth/data-centers-consume-millions-of-gallons-of-arizona-water-daily>.

156 Polom, *supra* note 155.

157 See *ibid.*

158 Hogan, "Big Data Ecologies", *supra* note 26 at 639, citing *The Quincy Valley Post-Register*.

159 See *ibid* at 639.

160 Rone, *supra* note 128 at 9.

engenders",[161] such as the addictive qualities of social media or the problems associated with advertising technology and information quality. In so doing, we

> overlook the coal-fired power plants and energy-intensive cooling systems that translate kinetic actions (all those keyboard strokes and touchscreen swipes) into data. While both the psychosocial effects of "plugging in" and the mounting "e-waste" that each phone, tablet, and laptop perpetuates have garnered public attention, the cloud's infrastructure and the energy that runs it … remain in the shadows.[162]

As noted in a 2019 Greenpeace report, "how we power this digital infrastructure is rapidly becoming critical in determining whether we will be able to stave off climate change in time to avoid planetary catastrophe."[163] This tripartite problem of high resource demand, low visibility, and extractive relationships with local communities presents a challenge for policymakers committed to a just energy transition and meeting climate change milestones. In the following section, I explore aspects of the data centre that must be considered when planning the future growth of the industry.

IV. SITUATING THE DATA CENTRE

Johnson has suggested that focusing only on the data centre industry's environmental impacts, which is to say its materiality, "does not go far enough without sustained attention to the politics of place."[164] A focus on environmental impacts is part of the reason we see data centres moving north, seeking cooler climes, and using renewable energy. Drawing on her extensive ethnographic work on the data centre industry in Iceland, Johnson states that,

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161 Allison Carruth, "The Digital Cloud and the Micropolitics of Energy" (2014) 26:2 Public Culture 339 at 345.

162 *Ibid* at 346.

163 Cook & Jardim, *supra* note 60 at 3.

164 Center for European Studies at UF, "Making Data's 'Natural' Home: Geographies of Digital Development in Europe's New 'Node Pole'" (30 November 2021) at 00h:34m:54s, online (video): *YouTube* <youtu.be/JvR1D4F1hn8>.

> this neat solution gets complicated . . . [if] we shift scales from the general to particular—this cable, that river, that road—we see that the infrastructure that converts Iceland's landforms and earth processes into consumable resources is itself the product of contentious and inequitable histories, specifically American military occupation and international corporate extractivism.[165]

Hogan has observed that this neat solution, which involves Big Tech "partnering with nature"[166] to make its operations more sustainable, actually results in it "carv[ing] out a more important (and direct) role for itself as custodian and manager of natural resources."[167] Through various commitments to use 100% renewable energy, becoming net-zero, and carbon neutral, Big Tech inserts itself in the flow of resources as seemingly inert. However, as Tung-Hui Hu notes, there is a "problem with sustainability . . . it advocates for the infinite extension and reproduction of present-day values into the future."[168] If we shift our focus from the general to the specific, as suggested by Johnson, we can recognize that this "move to 'green' our communications infrastructure starts to more closely resemble a means of feeding and watering the machine, by privileging clean water and electricity for communication ends than for human ends".[169] Data centres are not neutral.

Johnson's comments also echo the words of Langdon Winner in "Do Artifacts Have Politics?", where he wrote that, "[t]hose who have not recognized the ways in which technologies are shaped by social and economic forces have not gotten very far."[170] The politics of a data centre must be considered in addition to its materiality. This reminder to pay heed to the context of particular spaces is reminiscent of the caution of the "pitfalls of spatial fetishism"

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165 *Ibid* at 00h:35m:25s.

166 Hogan, "Big Data Ecologies", *supra* note 26 at 636.

167 *Ibid* at 632.

168 Hu, "Black Boxes and Green Lights", *supra* note 139 at 83.

169 Hogan, "Big Data Ecologies", *supra* note 26 at 640.

170 Langdon Winner, "Do Artifacts Have Politics?" in Langdon Winner, ed, *The Whale and The Reactor*, 2nd ed (Chicago: University of Chicago Press, 2020) 19 at 21.

referenced in Part I. For this reason, I have defined the problem with data centres as not just an environmental problem, but a problem enmeshed with other sociotechnical elements. I discuss two of these elements below. First, I argue that the data centres are not just hard to notice visually but also conceptually. Second, I discuss how the relationship between data centres and the geographies they occupy is extractive.

A. VISIBILITY: THE CLOUD AS METAPHOR

Nascent technology often presents a problem for language. As Christian Katzenbach and Stefan Larsson write, "[e]merging phenomena typically lack a name, so we apply existing words to a new thing, although they might technically not be applicable."[171] Thus we have used "words and iconography that bind physical letters to email, film photography to pixelated imagery, and so on."[172] When we make this connection, we also add rigidity to how we conceptualize such emergent phenomena. The metaphor, or perhaps more appropriately the "skeumorph",[173] is particularly important for legal practitioners and regulators as it "provides a critical shorthand, narrowing the gap between the world in which we live . . . and the world for which the law was written."[174]

When we use the cloud as a conceptual shorthand, we simplify the vast global network of data centres, fibre-optic cables, hydroelectric power stations, water reservoirs, and other necessary infrastructure into a "single, virtual object".[175] As a

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171 Christian Katzenbach & Stefan Larsson, "Imagining the Digital Society—Metaphors from the Past and Present" (15 May 2017), online: *Humboldt Institute for Internet and Society* <hiig.de/en/imagining-the-digital-society-metaphors-from-the-past-and-present>.

172 Lex Gill, "Law, Metaphor, and the Encrypted Machine" (2018) 55:2 Osgoode Hall LJ 440 at 457.

173 Stefan Larsson, "Metaphors, Law and Digital Phenomena: The Swedish Pirate Bay Court Case" (2013) 21:4 Intl JL & Information Technology 354 at 358 (the "reuse of old concepts for new phenomena" at 378).

174 Gill, *supra* note 172 at 457.

175 Tung-Hui Hu, *A Prehistory of the Cloud*, (Cambridge: The MIT Press, 2015) at X [Hu, *A Prehistory of the Cloud*].

metaphor, the cloud represents well the concept of weightlessness and convenience of cloud services. I witnessed this convenience as I drafted this article using Microsoft Word and saved my working file using their OneDrive service. Though I mostly worked at home on my desktop computer, I was always free to work on the go and pull my draft (from a Microsoft data centre) to any device with an internet connection. Though it aptly conveys the convenience afforded by data centres, the cloud metaphor also collapses and severs the data centres' complex material infrastructure. As Lex Gill writes, "once information has been surrendered to 'the cloud,' there is a sense that it has been depersonalized, disembodied, harder to locate—it becomes somewhere else and someone else's."[176]

Bridle notes that "the idea of 'the cloud' is almost as old as the internet",[177] though the notion of vaporous information transfer has a longer history. Take, for instance, the following inscription on the 1908 sculpture, "The Progress of Railroading", displayed at the entrance of Union Station in Washington DC:

> Electricity. Carrier of light and power
> Devourer of time and space. Bearer
> Of human speech over land and sea
> Greatest servant of man. Itself unknown
> Thou hast put all things under his feet
> …
> Override the Ocean. And make
> The very ether carry human thought
> The desert shall rejoice and blossom
> As the rose.[178]

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176 Gill, *supra* note 172 at 462.

177 Bridle, *supra* note 4. See also Hu, *A Prehistory of the Cloud*, *supra* note 175 (tracing the "cloud" conceptualization to a 1971 diagram "[d]rawn by Irwin Dorros, director of network planning for AT&T" which "utilizes a series of three clouds to describe the network behind AT&T's new Picturephone service" at X).

178 "The Progress of Railroading, (sculpture)" (Accessed 1 December 2021), online: *Art Inventories Catalog Smithsonian American Art Museum* <siris-

Though this benediction might often be overlooked by the morning commuter glued to their social media feed of human thought, the idea that information is transmitted by ethereal clouds (and not material infrastructure) is so embedded in our relationship with information and communications technology that it attains a mythical quality.

I suggest that the cloud is mythical because it represents "a way of understanding the world that is not problematic, that we are not fully conscious of, that seems, in a word natural . . . [It] is a way of thinking so deeply embedded in our consciousness that it is invisible."[179] As Hu writes, "the cloud has become so naturalized in everyday life that we tend to look right through it, seeing it uncritically, if we see it at all."[180] Hitting a similar note, Carruth remarks that "the web is so ubiquitous for those cultures and communities that are 'plugged in' that its infrastructure becomes imperceptible."[181]

Whether myth or metaphor, the cloud concept obscures and abstracts its enabling infrastructure. Consequentially, the spatial boundary between the digital and material imperceptivity shifts. It is in this sense that the data centre represents a bleeding edge site. At this site, the digital extends into the natural environment through power and fibre-optic supply routes connecting data centre beachheads.[182] The cloud metaphor provides cover for the prioritization of the digital at the expense of the material. Thus, we do not immediately recognize that the expansion of the

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artinventories.si.edu/ipac20/ipac.jsp?session=E690R04447202.1494&profile=ariall&source=~!siartinventories&view=subscriptionsummary&uri=full=3100001~!18695~!14&ri=3&aspect=Browse&menu=search&ipp=20&spp=20&staffonly=&term=Saint-Gaudens,+Louis,+1854-1913,+sculptor.&index=AUTHOR&uindex=&aspect=Browse&menu=search&ri=3>.

179 Neil Postman, *Amusing Ourselves to Death*, (Toronto: Penguin Group, 1985) at 79 (interpreting Roland Barthes' use of the term).

180 Hu, *A Prehistory of the Cloud*, *supra* note 175 at XII.

181 Carruth, *supra* note 161 at 343.

182 Sometimes, literal beachheads. See e.g. Sean Gallagher, "Why a Former Nazi Sub Base in Marseille is Becoming a Data Center" (25 June 2019) online: *Ars Technica* <arstechnica.com/information-technology/2019/06/why-a-former-nazi-sub-base-in-marseille-is-becoming-a-data-center/>.

"metaverse" necessitates the yielding of natural landscapes to hyperscale machine habitats and energy projects. As Taylor observes, "one of the great myths of cloud storage is its space-saving potential. While living room shelf-space has been liberated from the weight of DVDs, CDs, books and video games, this 'weight' has not disappeared. Rather, it has simply been relocated into these expansive data warehouses."[183] In other words, the cloud represents a shift in resources, not an elimination of them. "Going paperless" in favor of digital storage does not mean that information is now free and infinite.[184]

B. EXTRACTION

Nicholas Blomley has remarked that "[p]ower is always already spatial, but it is neither uniform, nor continuous over space. It is actualized in different and combined modes *precisely because spatiality makes a difference to the effects that power can have*."[185] An implicit and hidden spatiality undergirds the five factors I discussed in Section II-B above, which is that "many of the most significant social and economic nodes of the Information Society sit at the intersection of traditional, material infrastructures like railroads, power grids, and river systems."[186] The silent histories of capital concentration[187] imbue data centre development with problematic politics that condone extractive relationships with local communities.[188] This relationship is encapsulated in the

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183 Taylor, "Failover Architectures", *supra* note 14.

184 *Ibid*.

185 Nicholas Blomley, "From 'What?' to 'So what?': Law and Geography in Retrospect" in Jane Holder & Carolyn Harrison, eds, *Law and Geography* (Oxford: Oxford University Press, 2003) 17 at 23, citing John Allen, "Spatial Assemblages of Power: From Domination to Empowerment" in Doreen B Massey, John Allen & Phillip Sarre, eds, *Human Geography Today* (Cambridge: Polity Press, 1999) 194 at 212 [emphasis in original].

186 Ensemenger, *supra* note 27 at s 18–19.

187 See e.g. Pickren, "The Factories of the Past are Turning into the Data Centres of the Future", *supra* note 10.

188 See e.g. Cooper, *supra* note 23 (observing that "Big Data appears globally distributed, but the determinants of its material form are propped up by old

following passage from Thomas Pynchon's 2013 novel, *Bleeding Edge*, in which the wealthy tech CEO, Gabriel Ice, bluntly describes the data centre power play:

> More and more servers together in the same place putting out levels of heat that quickly become problematic unless you spend the budget on A/C. Thing to do," Ice proclaims, "is to go north, set up server farms where heat dissipation won't be so much of a problem, take your power from renewables like hydro or sunlight, use surplus heat to help sustain whatever communities grow up around the data centers.[189] Domed communities across the Arctic tundra.[190]

In this northern light, the data centre becomes visible as a mining colony. Indeed, as Asta Vonderau describes, "the discovery of 'cold air' as a new natural resource not only opens novel possibilities for making profits. It also triggers a transformation of complex relationships between local communities, industries, and natural environments."[191] Contrary to Ice's proclamations, it is data centres that grow around communities, not the other way around.

As Johnson notes, "commercial data centres . . . are neither producers nor consumers. Rather, they store data, on its way to somewhere else, or process data, on behalf of someone else."[192] Johnson suggests that the relationship between a community and data centre is one of "ambivalent integration, rather than a failure to include" as these infrastructures are "flow *through* rather than flow *to*".[193] Indeed, despite the rhetoric of politicians heralding data centres as evidence that a region is "establishing itself as a

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nationalisms, colonial violence, and geopolitical frictions, all of which leave deep traces in our data infrastructures" at 5).

189 This phenomenon is called "Industrial Symbiosis". See e.g. Cristina Ramos Cáceres et al, "Data-Center Farming: Exploring the Potential of Industrial Symbiosis in a Subarctic Region" (2022) 14:5 Sustainability 2774; Velkova, *supra* note 25.

190 Thomas Pynchon, *Bleeding Edge* (New York: The Penguin Press, 2013) at 310.

191 A Vonderau, "Storing Data, Infrastructuring the Air", *supra* note 26 at 2.

192 Johnson, *supra* note 19 at 78.

193 *Ibid* [emphasis in original].

dominant player in digital technology and innovation",[194] data centres do not create many jobs[195] and are merely communication nodes not innovation hubs.

This extractive and "flow through" relationship becomes particularly problematic when a region encounters the limits of its grid capacity. Frans Libertson, Julia Velkova, and Jenny Palm have introduced the concept of "energy gentrification"[196] in order to initiate a dialogue that considers "[w]hich societal functions should be prioritized when the electricity grid reaches its maximum capacity".[197] The authors explore the effects of the large data centre industry in Sweden and describe grid capacity problems suffered in the region due to growth and increased electricity demand, in particular, the growth and demand of the data centre industry.[198] Because the grid was not designed to handle the city-like electricity demands of data centres,[199] the resulting energy shortfall has "suppress[ed] and displace[d] local companies and regional infrastructural projects."[200] Without proper planning, energy conflicts may occur between data centres, residents, and local businesses which will necessitate prioritization.[201] The authors introduce the concept of "energy

194 Marcy Nicholson, "Amazon to Create a Cloud Infrastructure Region in Western Canada", *BNN Bloomberg* (8 November 2021), online: <bnnbloomberg.ca/amazon-to-create-a-cloud-infrastructure-region-in-western-canada-1.1678769> (as former Alberta Premier Jason Kenney did with respect to Amazon announcing plans to expand its data centres in Alberta).

195 See e.g. Brodie & Velkova, *supra* note 25 at 880; Jacobson & Hogan, "Retrofitted Data Centres", *supra* note 12 at 79–80; Josh O'Kane, "Amazon has Big Data-Centre Plans for Alberta–But What's the Economic Benefit?", *The Globe and Mail* (28 March 2022), online: <theglobeandmail.com/business/article-amazon-data-centre-alberta-kenney>.

196 Frans Libertson, Julia Velkova & Jenny Palm, "Data-Center Infrastructure and Energy Gentrification: Perspectives from Sweden" (2021) 17:1 Sustainability: Science, Practice & Politics 152 at 152.

197 *Ibid*.

198 See *ibid* at 154.

199 See *ibid*.

200 *Ibid* at 158.

201 See *ibid* at 152.

gentrification" to "highlight the potential dangers of failing to recognize that energy also constitutes a societal resource, and like housing or any other resource of the built environment, it is exposed to the risk of exploitation if left unprotected."[202]

The aftermath of natural disasters has brought this prioritization into stark relief as data centres have become muster areas, able to provide power and other amenities to those without access.[203] Even more concerning are situations where data centres are prioritized during times of limited power. During recent rolling blackouts in North Carolina brought about by a winter storm, it was reported that while "residents were plunged into cold darkness . . . the power-hungry [cryptocurrency] mine kept humming."[204]

Through this concept we can see another sort of bleeding edge at data centre sites. Because data centres compete for electricity with local communities, are backed by global capital, and yield low amounts of job creation, this global industry threatens to bleed into and displace local interests. This sense of losing ground is reflected in the following comments of a local businessperson made in response to the proliferation of data centres in Quincy, Washington (an agricultural region with cheap electrical power): "I understand that it's a necessary situation for us as a society and

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202 *Ibid* at 157. This concept could also be applied to the water use demanded by data centres as well. For instance, in Arizona, "state reservoirs like Lake Mead and rivers like the Colorado are so low that federal restrictions are likely to be triggered on Arizona's water allocation as early as next year": Polom, *supra* note 155. Despite this, data centres continue to be developed in that region that would draw on these water sources.

203 See e.g. Hogan, "Big Data Ecologies", *supra* note 26 (stating that "[a]s Hurricane Harvey devasted Houston with catastrophic flooding . . . data centers in the area remained operational" at 632); Steven Gonzalez Monserrate, "The People of the Cloud", (28 July 2022), online: *Aeon* <aeon.co/essays/downtime-is-not-an-option-meet-the-stewards-of-the-cloud> (stating that "[d]uring [Hurricane] Maria . . . we were part of the relief and recovery effort . . . . people from all over the island came to us, and we let them in").

204 Bill Weir, "How the Blare of a Crypto Mine Woke Up this Blue Ridge Mountain Town", *CNN* (19 January 2023), online: <cnn.com/2023/01/19/us/north-carolina-crypto-mine-noise-weir-wxc/index.html>.

the way we want to live. But I don't think it's benefitting Quincy … I think we're taking one for the team, to tell you the truth."[205] These asymmetric impacts raise energy justice concerns, and therefore we should ask whether this system "fairly disseminates both the benefits and costs of energy services, and [is] one that has representative and impartial energy decision-making."[206]

Before moving to my proposed response, I note that data centres may benefit some communities, especially in the case of data centres moving into empty buildings left by heavy industry. Some communities will still benefit from minimal job creation instead of stagnation. The collection of a reduced business tax is likely preferable to no collection at all. Data centres can fill the shoes left by outdated heavy industry and purchase the surplus power caused by such exits[207] and may present the best economic use for a particular building.[208] Recognizing these benefits, however, does not neutralize the fact that some geographies have been terraformed by problematic histories[209] and that the best social use of a building may not include the operation of computer equipment.

V. POLICY RESPONSE

Throughout this article I have referred to the data centre as a hybrid and bleeding edge site. This is because the data centre is difficult to fit into one category. At times it resembles a hermit crab, filling the shoes of lost industry and re-introducing economic benefit to a community with surplus electrical capacity. At other

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205 Glanz, "Data Barns", *supra* note 152.

206 Benjamin K Sovacool & Michael H Dworkin, "Energy Justice: Conceptual Insights and Practical Applications" (2015) 142 Applied Energy 435 at 436.

207 See e.g. Barker, *supra* note 106 ("The situation is there is surplus power in Labrador West and they don't have a use for it right now and we are filling a huge gap that's been left by the iron ore industry").

208 See e.g. *Digital 55 Middlesex, LLC v Board of Assessors of the Town of Billerica*, 2020 Mass Tax Lexis 59 (Mass Tax App Ct) (wherein the Massachusetts Appellate Tax Board "found and ruled that the highest and best use for the subject property was its existing use as a data center" at ATB 2020-229).

209 See e.g. Gallagher, *supra* note 182.

times it resembles the notoriously invasive zebra mussel, disrupting local systems, spreading through undeveloped land, and crowding out local interests.[210] Just as the zebra mussel is a concern for its effect on biodiversity, so too are data centres a concern for their potential to "reduce the capacities or relations"[211] of the local community.

As discussed in Section II, the data centre can be viewed through the lens of global digital infrastructure and local building. Sometimes the data centre industry pushes the cloud metaphor, emphasizing the affordances of convenient and seamless access to information. For bunkered data centre operators however, it is their stone-like permanence that is core to their messaging. Different uses of the cloud can also change our conception of data centres. At times cloud computing provides users (and corporations)[212] with a contemporaneous digital record[213] of their activities. At other times data centres represent an archive, preserving our information from the threat of disaster or simply the fallibility of human memory. Because data centres can bear many conceptualizations and business models, it is not easy to slot them into a discrete regulatory scheme.

In the following section, I will focus on regulating the local aspect of data centres as well as their building characteristics. In assessing this regulatory approach, I will focus on how law can affect the spatiality of data centres. As a result, I focus on the

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210 Zebra mussels are also filter feeders, reflecting the flow through nature of data centres.

211 Sy Taffel discusses an ecological ethics framework for media and materiality whereby we might assess "good acts being those which augment the capabilities of the actors—such as symbiosis and mutualism—while bad acts reduce the capacities or relations of the actors": Sy Taffel, "Escaping Attention: Digital Media Hardware, Materiality and Ecological Cost", (2012) 13 Culture Machine at 20.

212 See generally Shoshana Zuboff, *The Age of Surveillance Capitalism* (New York: PublicAffairs, 2019). See also Mosco, *supra* note 20 at 10.

213 Or perhaps a hoard of biographical information. See Charlie Warzel, "Confessions of an Information Hoarder", *Galaxy Brain* (25 March 2022), online: *The Atlantic* <newsletters.theatlantic.com/galaxy-brain/623d45efdc551a00208acf88/data-hoarding-google-health-effect>.

possibility of land use law to respond to the problem of data centres.

Though there are other possible regulatory sources, including internet governance laws, competition law, and taxation, these sources of regulation fall outside the scope of this paper. The federal government also likely has a strong jurisdictional claim to the regulation of the data centre industry as interprovincial/international infrastructure. By reason of their "flow through" behaviour and large scale, data centres are inherently interprovincial and international sites. The cloud drifts between provinces and nations seamlessly. As Burrington notes, "an estimated 70 percent of internet traffic goes through"[214] Data Center Alley in Northern Virginia daily. Data centres are not merely local concerns, they eschew borders and support the flow of global internet traffic. Considering the importance of electron/photon arbitrage and the "export of computational work" to the data centre industry,[215] it may be that the Canada Energy Regulator[216] could be an appropriate legislative body for the data centre industry; however, more research is needed to explore this further.

A. PLANNING LAW

Because land use is a matter of "a merely local or private [n]ature"[217] and concerns "[p]roperty and [c]ivil [r]ights"[218] in a province, Canadian land use laws are quite diverse as they reflect local concerns. Provinces delegate their authority to regulate the use of provincial land to municipalities pursuant to enabling legislation. Municipalities exercise this authority by instituting

214 Burrington, "The Cloud Is Not the Territory", *supra* note 26.

215 See *supra* note 89 and accompanying text.

216 The Canada Energy Regulator has jurisdiction over energy exports across international borders. See *Canadian Energy Regulator Act*, SC 2019, c 28, s 355.

217 *Constitution Act*, *1867 (UK)*, 30 & 31 Vict, c 3 s 92(16) reprinted in RSC 1985, s 92(16).

218 *Ibid* at s 92(13).

zoning by-laws which "[regulate] the use of land by delineating an area and prohibiting uses of land within that area."[219]

Land use laws are able to influence "local agency and power relations"[220] because as noted above, "spatiality makes a difference to the effects that power can have".[221] Laws regulating the use of land have an inherent spatiality to them[222] as they have a direct impact on the space that a landowner can influence. For example, height restrictions in the city of Paris[223] have maintained its unique visual identity, connecting present spatial texture to the city's rich history. Land use laws thus present an ideal opportunity to regulate the spatial drift of the digital into the material at the data centre bleeding edge. By prescribing procedural friction, land use laws can also provide on-ramps for public and participatory decision-making regarding data centre deployment.

Such laws are "recognized as promoting public welfare, ensuring orderly development and the protection of residential neighbourhoods from the intrusion of industry and commerce."[224] Included in the promotion of public welfare is often a commitment to the environment and sustainable development. Such a commitment is usually found in the official plan of a municipality. For instance, the Regional Municipal Planning Strategy for Halifax, Nova Scotia,[225] begins its list of plan objectives with a heading

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219 Robert Doumai & Patricia Foran, *Ontario Planning Legislation & Commentary* (Markham: LexisNexis Canada Inc, 2012) at 54.

220 Which are themes that "research on digital infrastructures" has paid special attention to: Rone, *supra* note 128 at 6.

221 Blomley, *supra* note 185 at 23 [emphasis omitted], citing Allen, *supra* note 185 at 212.

222 See e.g. Gareth A Jones, "Camels, Chameleons, and Coyotes: Problematizing the 'Histories' of Land Law Reform", in Jane Holder & Carolyn Harrison, eds, *Law and Geography* (Oxford: Oxford University Press, 2003) 169 at 170.

223 See e.g. Feargus O'Sullivan, "Could the City of Light Become the City of Height?", *Bloomberg* (20 September 2013), online: <bloomberg.com/news/articles/2013-09-20/could-the-city-of-light-become-the-city-of-height>.

224 Doumai & Foran, *supra* note 219 at 54–55.

225 Halifax Regional Municipality, *Regional Municipal Planning Strategy* (October 2014), online (pdf): <halifax.ca/sites/default/files/documents/about-the-city/regional-community-planning/RegionalMunicipalPlanningStrategy.pdf>.

titled "Environment, Energy and Climate Change" which commits the municipality to promoting development that will "[c]onserve energy and respond to climate change" and "[a]dopt development practices that sustain air, land, water and groundwater resources and respond to climate change".[226] Land use laws are also powerful sites for environmental and energy regulation as "The Federation of Canadian Municipalities . . . estimates that municipal governments directly or indirectly influence about 44% of greenhouse gas (GHG) emissions in Canada."[227] The regulation of data centres at the local level would be in line with typical environmentally conscious municipal commitments and are potential sources of effective and direct regulation of data centre land, energy, and water use.

In conducting research for this article, I have reviewed Halifax, Toronto, and Vancouver land use laws[228] to determine whether they specifically consider the outsized energy demand of data centre developments. Though each region has definitions for data centre uses,[229] there does not seem to be explicit attention paid to the special demands of the data centre industry. This said, the Toronto and Halifax by-laws list data centre uses as permitted uses in various commercial and industry zones whereas the Vancouver by-law lists data centres as a use that is subject to conditional approval in specific transportation and storage zones. Conditional zoning gives broader discretion to a municipality to implement

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226 *Ibid* at 10.

227 Halifax Regional Municipality, *Corporate Plan to Reduce Greenhouse Gas Emissions 2012–2020*, by Lauralee Sim (August 2011) at 1, online (pdf): <cdn.halifax.ca/sites/default/files/documents/about-the-city/energy-environment/HRM%20Corporate%20Plan%20to%20Reduce%20GHG%20Emissions%202012-2020_0.pdf>.

228 I note that the *Nunavut Planning and Project Assessment Act*, SC 2013, c 14 would likely apply to a proposed data centre development in that territory. See Daniel W Dylan, "The Complicated Intersection of Politics, Administrative and Constitutional Law in Nunavut's Environmental Impacts Assessment Regime" (2017) 68 UNBLJ 202 (for a review and discussion of that regulatory scheme).

229 Vancouver refers to "bulk data storage", Toronto uses "software development and processing", and Halifax uses "data storage centre use".

conditions on development proposals prior to granting a development permit. These conditions can persist despite changes in land ownership as they "require the owner to enter into an agreement which may then be registered on title"[230] and are akin to development agreements (instruments used in the case of a variance or zoning amendment). The relevant section of the Vancouver by-law requires the administrative decision maker to first consider the intent of the by-law and relevant policy and guidance documents as well as submissions from interested parties prior to granting approval to a project.[231]

The Vancouver approach is an appropriate starting point for municipalities to implement in areas zoned for data centre uses as it provides the opportunity for a weighing of a data centre's energy use against the sustainability, energy, and water use commitments found in municipal planning documents. It also provides the opportunity for public participation in the decision-making process. This said, it still represents an ad hoc approach to regulation and as Rone notes, "[m]eaningful participation . . . [is] made difficult . . . by the lack of information on data centres"[232] and that negotiations between company and municipality can be surrounded in secrecy.[233] A regulatory framework seeking to be energy-just would both "guarantee that energy procedures are fair and that stakeholders have access to information and participation in energy decision-making."[234] In addition to the procedural benefits of conditional zoning, express provisions placing conditions on data centre use, requiring energy use assessments, and transparency measures are necessary.

As Libertson et al observe, "the capacity limitations of the energy grid have not received adequate attention in conjunction with the planning of data centers".[235] I propose that an energy use

230 Doumai & Foran, *supra* note 219 at 61–62.

231 City of Vancouver, By-law No 3575, *Zoning and Development By-law* (November 2022), I-2 District Schedule, s 2.1.

232 Rone, *supra* note 128 at 11.

233 See *ibid* at 11.

234 Sovacool & Dworkin, *supra* note 206 at 437.

235 Libertson, Velkovam & Palm, *supra* note 196 at 153.

assessment be an explicit condition for data centre land use approvals. Such an assessment would evaluate the energy demand of the data centre within the context of the region's energy use and future energy growth and transition plans. I recommend that assessment language be added to land use laws as they relate to data centre zoning. Provisions mandating disclosure of information could be folded into this requirement. Particularly important is increased transparency concerning proposed water treatment at the data centre and the chemical composition of wastewater. The following language, excerpted from Ontario's Oak Ridges Moraine Conservation Plan may be a useful starting point:

> Municipalities shall ensure that the development of new infrastructure or the upgrading or extension of existing infrastructure is supported by the necessary studies, assessments and documentation such as infrastructure master plans, asset management plans, land use and financial scenarios, watershed studies and subwatershed plans, environmental assessments and other relevant studies that [further the goals of sustainability, financial success, green infrastructure etc.][236]

Furthermore, using the framework of "energy gentrification" we can conceptualize the energy demand of a data centre as a by-product that has an effect on the local community, thus bringing it within the ambit of performance zoning.[237] I recommend that express conditions on data centre uses be specified in land use laws, specifically conditions that prescribe minimum power and water usage efficiency standards. This regulation would be a type of performance zoning which establishes "performance criteria directly related to the impact of the use on nearby uses and users of land."[238] In the context of "energy gentrification" the resource demand of a data centre can be understood as impacting the local community's access to energy because data centres can have an outsized impact on grid

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[236] *Oak Ridges Moraine Conservation Plan*, O Reg 140/02, s 41(1.2).

[237] Lane Kendig et al, *Performance Zoning* (Washington, DC: Planners Press, 1980).

[238] Halsbury's Laws of Canada, *Planning and Zoning* (2021 Reissue) at HPZ-112 ("[e]stablishment of performance standards for uses").

capacity. Performance zoning has been used to set parameters related to noise levels[239] and may present a local model for setting efficiency parameters for industries with high-resource demands. Specific compliance standards should be prescribed in the by-law and periodically updated in accordance with leading industry "power usage effectiveness" and "water usage effectiveness" benchmarks.[240] Importantly, the standard should be achievable, as "[t]he authority to regulate the use of land will not support the absolute prohibition of its use for any purpose directly or indirectly."[241] Relatedly, care must be taken to exempt enterprise data centres that are accessory uses, as leading industry usage effectiveness requires expertise and investment, and local businesses should not unduly suffer from unattainable standards. Furthermore, it is possible that an unattainable standard could be interpreted as a de facto prohibition.

Mandating such standards should not overly inhibit economic development in Canada as the data centre industry has branded itself as a green industry and many hyperscale firms have pledged to run their data centres using renewable energy. This regulation merely formalizes these promises and ensures that the "compromise" made by hyperscalers like Google is not at the expense of Canadian environments. Furthermore, enforcement of performance standards could be delegated to by-law enforcement

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239 *Ibid.*

240 Power usage effectiveness (PUE) is "the total amount of energy used by a data center divided by the energy used by its IT equipment": Masanet et al, *supra* note 28 at 984. Water usage effectiveness (WUE) is "defined as the ratio of a DC's total onsite water use to its IT electricity use, expressed in units of liters per kWh": Nuoa Lei & Eric Masanet, "Climate- and Technology-Specific PUE and WUE Estimations for U.S. Data Centers Using a Hybrid Statistical and Thermodynamics-Based Approach" (2022) 182 Resources, Conservation & Recycling at 2 [citation omitted]. Additional standard setting could be drawn from best practices guidelines published by the European Energy Efficiency Platform's Data Centres Code of Conduct. See Mark Acton, Paolo Bertoldi & John Booth, "2022 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency" (2022), online (pdf): *European Commission* <e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc128184_jrc128184_jrc128184_2022_best_practice_guidelines-1.pdf>.

241 Doumai & Foran, *supra* note 219 at 60.

officers and certification could be subject to ongoing disclosure of usage metrics thereby increasing transparency of this industry.

Finally, the perspective of planning and resource allocation is an appropriate frame of reference to mitigate the problems identified with data centres in this paper. These developments must be planned with care not only to mitigate risks such as "energy gentrification" but also to possibly identify benefits such as "industrial symbiosis". The waste heat generated by data centres can be reused by complementary industries, but this requires foresight and attention to the distance between the data centre and possible symbiotic industries, like greenhouses.[242]

VI. CONCLUSION

The Battle of the Argonne is a 1959 painting by the surrealist artist, René Magritte.[243] Two large floating objects occupy the centre of Magritte's canvas. These rounded objects take similar forms and volumes, yet one appears to be made of stone and the other cloud. Each object floats below a blue sky and crescent moon and above a shadowy landscape depicting masses of silhouetted buildings and trees. The enormity of the stone that hovers above the human dwellings evokes a sense of precarity. Is disaster imminent? Or will the stone behave like a cloud; float away, dissipate, and be forgotten.

This article has examined the weighty elements of the cloud: data centres. I have identified the issue with data centres as being a tripartite problem of high resource demand, low visibility, and extraction. This said, there are data centres that are exceptions to each prong of this problem. By locating in environments with cool

[242] See Cáceres et al, *supra* note 189 at 18–19; Proposed legislation in Germany unilaterally requiring "new data centers . . . have 30 percent of their waste heat used by other organizations from 2024, and 40 percent from 2027" has been viewed as "unrealistic" by the industry: Peter Judge, "Concerned about Germany's 'Data Center Prevention' Law? You Asked for it!" (18 November 2022), online: *Data Center Dynamics* <datacenterdynamics.com/en/opinions/concerned-about-germanys-data-center-prevention-law-you-asked-for-it>.

[243] Vincent Mosco considers a different Magritte painting to discuss cloud computing. See Mosco, *supra* note 20 at 14.

air and water, data centres can greatly reduce waste heat and be highly efficient in their energy use. Bunkered data centres desire to be visible, otherwise their primary business offering, physical security, could be overlooked by potential clients. Finally, "hermit crab" data centres might alleviate some of the economic pressure faced by former industrial towns that have surplus energy capacity on their grid through the creation of jobs and generation of tax revenue.

On the other hand, using the myth of digital permanence as a vector, a stone has settled and sustains itself, unseen in the cloud. If we do not have a plan to deal with the problem identified in this article, then the environmental hazards and energy justice issues associated with this industry will drift across landscapes and terraform them in tragically expected ways. We can see the danger of the stone by questioning why it is situated precariously above nature and how it operates within nature.

I do note, however, that consumers have a role in this industry too. The growth of the digital economy, the prioritization of speed, and the excessive amounts of digital data sitting idle on the public cloud, are also consequences of the relationship users have with this technology. As Carruth states, "desires to share experiences online and to access data from anywhere provide the foundation on which"[244] the data centre industry profits. As I remarked earlier, cloud storage was a great convenience to me during the drafting of this article (though it was not a necessary condition). In addition to possible regulatory avenues, changes in user behaviour are also necessary to access benefits that would follow from degrowth.

Louise Amoore writes that "[u]nderstood as a spatial arrangement, materialized in and through data centres, the abstract deterritorialized cloud is thus reterritorialized as an intelligible and governable entity."[245] In this article, I have conceptualized the data centre as a bleeding edge site; a liminal site of digital and physical territory, where the abstract becomes material. As Amoore suggests, the material site is governable. As

[244] Carruth, *supra* note 161 at 360.

[245] Amoore, *supra* note 57 at 8.

such, I have suggested that land use law can viably influence the spatiality of data centres. At the core of the problem with data centres is the excessive use of resources. Land use laws are an apt policy lever to deal with this issue as they are "developed to protect the public health, safety, and welfare by preventing the misuse and overcrowding of land and by protecting individuals from adverse impacts of neighboring land uses".[246] In other words, planning law is concerned with the allocation of resources. For this reason, I have recommended using land use law as a regulatory approach with specific suggestions to incorporate the consideration of future allocation and prioritization of electricity and water between data centres and communities. Instituting procedural safeguards for public input and transparency measures at the local level can also address some of the energy justice issues that inhere in the problem I addressed in this paper. Since electricity devours space[247] at the data centre bleeding edge, we should be very intentional as to how this space is zoned.

Though I have considered cloud computing in this paper, coming down the pipeline is the apparent magic of "serverless computing", which Amazon advertises as providing the convenience to "[b]uild and run applications without thinking about servers".[248] Unlike Jobs in 2011, Amazon knows that you do not show your backend to your audience. As Pickren writes, "[i]f we begin to ask *why* and *how* this clustering of computing infrastructure occurs in 'distinct places' and not others, it becomes clear that big data and ubiquitous computing seize upon and assemble landscapes with particular political, historical, and geographical conditions."[249] Which is also to say, contrary to Amazon's marketing, we ought to think about servers.

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246 Kendig et al, *supra* note 237 at 5.

247 As suggested in "The Progress of Railroading, (sculpture)", *supra* note 178.

248 "Serverless on AWS" (last visited 15 December 2021), online: *AWS* <aws.amazon.com/serverless>.

249 Pickren, "The Global Assemblage of Digital Flow", *supra* note 24 at 231 [emphasis in original].

ANNEX I

View from the Sambro Creek Road of Eastlink Pennant Point Data Centre Entrance in Halifax Regional Municipality, Nova Scotia

Source: Author

ANNEX II

View from North Street of Bell Aliant Data Centre Building in Halifax Regional Municipality, Nova Scotia (front left perspective)

Source: Author

ANNEX III

"Maritime Telegraph & Telephone Company Limited" sign on Bell Aliant Data Centre Building in Halifax Regional Municipality, Nova Scotia

Source: Author

ANNEX IV

View from North Street of Bell Aliant Data Centre Building in Halifax Regional Municipality, Nova Scotia (front right perspective)

Source: Author

ANNEX V

View from Willow Street of Bell Aliant Data Centre Building in Halifax Regional Municipality, Nova Scotia (rear of building)

Source: Author

ANNEX VI

View from Agricola Street of Liberated Software Data Centre Building in Halifax Regional Municipality, Nova Scotia

Source: Author

ANNEX VII

View from Agricola Street of Liberated Software Data Centre Building in Halifax Regional Municipality, Nova Scotia (looking toward North Street)

Source: Author