Water use by data centres: An Irish Context

- **A Report Prepared for the Water Forum**

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Executive Summary

Ireland is emerging as a leading host of data centres in Europe and the Irish Government is supporting the expansion of the data centre industry, highlighting its contribution towards a technology-rich and innovative economy. There are however, growing concerns over the impact of the expanding data centre industry on Ireland's electricity grid and greenhouse gas emissions. The water requirements of data centres, on the other hand, have received little attention. Many data centres require large amounts of potable water to cool their IT processors, which is often the process that also requires large amounts of electricity. Due to its moderate climate, Ireland is seen as a sustainable location for data centres, where electricity and water requirements may be less than other parts of the world. There have been advancements in both energy and water efficient technologies, which instead use outside air to cool IT equipment, and Ireland's cool climate makes it a suitable location for this type of technology. To ensure sustainable management of our water resources, expansion of this industry must also consider its water requirements and the impacts on the water available for use within the catchment, along with the impact on the local aquatic ecosystems.

Introduction

Data centres are a large group of computer servers that store, manage and process data. They are essential to the digital economy and to our social and work lives, from social media platforms, online video calls, banking, retail, etc. In 2018, the Irish Government published a statement on the Role of Data Centres in Ireland's Enterprise Strategy[1] stating "Data centre presence in Ireland raises its visibility internationally as a technology-rich, innovative economy", placing Ireland on a map "as a location of choice for a range of sectors and activities that are increasingly reliant on digital capabilities including manufacturing, financial services, animation, retail and global business services".

Over the last few years data centres have made headlines due to their growing energy requirements and increasing pressure on Ireland's electricity grid. High energy consumption can be attributed to both running IT equipment, and also cooling the servers. The latest (2023) data on electricity use for Ireland show that data centres consume 21% of all metered electricity from the grid, increasing from 18% in 2022, as reported by the Oireachtas Library

[1] Government of Ireland (2018) gov.ie - Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy (www.gov.ie)

& Research Services (2024)[2]. Eirgrid estimates that by 2028, data centres could account for 29% of Ireland's electricity consumption in a median demand scenario.

Bitpower, who track Ireland's data hosting industry, stated that as of June 2023 there are 82 operational data centres in Ireland, with planning permission granted for an additional 40. Of the 82 operational data centres, Bitpower report that 77 are in Dublin (88%), 5 are in Meath and the remaining 5 are in Carlow, Cork and Limerick. In a global context, According to BT Ireland, Ireland has an international advantage to hosting data centres due to its moderate climate allowing cool exterior air to control the temperature of the server racks, reducing the need for power hungry air-conditioning units.

Water Requirements of Data Centres

While there has been considerable discussion and debate about the energy requirements of data centres, their water requirements have received less attention in Ireland. The consistent running of IT equipment generates a lot of heat, which must be compensated for by actively cooling the processors. This is often done using a system with cooling towers which distribute cool water to computer room cooling units, a process that uses considerably high volumes of water. Myton (2021) researched data centre water consumption and found that in some cases 57% of water used from data centres is sourced from potable water, i.e. treated water for human consumption, with additional indirect water requirements from electricity generation. However, in an attempt to reduce the high energy and water requirements for this cooling process, there have been advancements in cooling technologies in recent years; air cooling systems can draw outside air to cool the processers, which can result in considerable reductions in both energy and water demands.

Despite advancements in data centre cooling technology, air cooling methods still require peak cooling using water, for short periods of the year when temperatures are above 25^{o}C. An estimate of peak demand outlines that data centres can use from 0.5 million litres per day to 5 million litres per day, although usage at the upper end of that range is rare, according to figures gathered by the Sunday Business Post[3]. Peak water demand often coincides with prolonged periods of warm, dry weather, when low flows and decreased water levels in rivers and lakes result in reduced water availability for public water supplies (Gov statement 2022, Irish Water, NWRP).

The focus of water use at data centres has received some attention internationally, particularly in water stressed areas known to experience seasonal drought, such as California[4]. There is still very little attention given to this sector in Ireland. The Government's Statement on the Role of Data Centres in Ireland 2022[5] statement does include a section on water use, indicating they are low users of water nationally.

[2] Oireachtas Library & Research Service (2024). Data centres and energy (oireachtas.ie)
[3] Eolas (2020). Data centre water usage | Eolas Magazine
[4] Fitzgerald (2015). Data Centers and Hidden Water Use - WSJ
[5] Government of Ireland (2022). government-statement-on-the-role-of-data-centres-in-irelands-enterprise-strategy.pdf

Data centres – the Irish context

The Government's Statement on the Role of Data Centres (Government of Ireland, 2022) indicates that Uisce Éireann supplies approximately 608,000 megalitres of water annually, of which 0.13% (c.810 megalitres) is consumed across all known data centres. While this value indicates data centres are a low water user, a comparison of water consumed by data centres to a value of water supplied nationally, is not fully transparent on the pressure this industry may have regionally. Considering 87% of data centres in Ireland are in Dublin, with 93% located in the Greater Dublin Area (which includes Meath), a regional comparison should instead be made. The comparison should not be made with water supplied, considering 38% of water supplied is lost through leakage, so a more useful comparison would be of the water used by data centres relative to the regional water demand, to get a clear indication of the pressure that data centres have on our water resources in the Greater Dublin Area.

Along with a regional comparison of water use, seasonal peak requirements should also be assessed to indicate increased pressure during dry or drought conditions. According to Baringa (2024)[6] sustainable water use is a key solution for sustainable digital infrastructure in Ireland, and recommend that water solutions should always be local, taking into account relative water abundance or scarcity in a particular region. While Myton (2021)[7] reported that data centres in the USA consume ~0.14% of the water used in the country, this study also highlighted issues with transparency with less than a third of data centre operators measuring water consumption. This figure is also calculated on usage throughout the whole country, when there are likely large regional differences depending on where data centres are located and the local climatic conditions.

In 2021 Uisce Éireann indicated there are 24 data centres connected to public water supplies (*personal communications*), while there are 82 operational data centres in the country. It may be a case that some of these 82 data centres are small and fit under a different category of customers, or that single water connections may supply water to a number of data centres located on the same site.

It may also be a case that some data centres in Ireland have their own private water abstractions. Under the European Union (Water Policy) (Abstractions Registration) Regulations 2018, if you abstract 25,000 litres or 25m^3 of water or more a day, you must register this abstraction with the Environmental Protection Agency (EPA). As a comparison, a well supplying a single household typically abstracts less than 1m^3 of water per day. However, according to the EPA (*personal communication*), there is no option for data centres in the self-registration site for abstraction and therefore data centres with private abstractions must be registered as a different type of user. Abstractions less than 25m^3 currently do not have to be registered. For sustainable management of our water resources, the cumulative impact of public and private water abstractions should be monitored along a catchment.

When you consider that the vast majority of data centres in Ireland are located in Dublin, it should also be noted that there is already considerable pressure on the capacity of water supply in the Greater Dublin Area. According to Host in Ireland (June 2023) in addition to the

[6] Baringa (2022). A vision for sustainable data centres in Ireland | Baringa

[7] Myton (2021). (PDF) Data centre water consumption (researchgate.net)

82 operational data centres, a further 54 have been approved for planning or under construction, the majority of which are in Dublin. According to Uisce Éireann's draft Regional Water Resources Plan for the Eastern and Midlands (Uisce Éireann, 2021)[8], the Greater Dublin Area has a chronic capacity deficit and Uisce Éireann's built assets are operating beyond their sustainable operating capacity on a daily basis. Furthermore, some of the existing water abstractions in the Eastern and Midlands region are potentially unsustainable in the medium term; specifically, during drought periods. It is worth noting that these drought periods will coincide with the need for peak water usage at data centres in Dublin. Through their Regional Water Resources Plan, Uisce Éireann are planning to reduce the supply deficit and increase resilience in the Eastern and Midlands region through large water transfers from the River Shannon, along with increasing the interconnectivity of different water resource zones.

Ireland's Climate Action Plan[9] indicates that climate change in Ireland will cause further pressure on water resources with "*Increased water demand as a result of the increased frequency of heatwaves, leading to further strain on water transmission and distribution networks, as well as on supply (abstraction and storage)"*. Uisce Éireann's National Water Resources Plan indicates that 58% of water resource zones have a supply risk in normal conditions and 66% are in deficit during drought conditions. In 2019 the Department of Housing, Local Government and Heritage (DHLGH) developed the Water Quality and Water Services Infrastructure - Climate Change Sectoral Adaptation Plan[10] to present contingency plans to address the risks posed by climate change; this report outlined the future projections of climate change in Ireland which include decreases in summer precipitation, with increased frequency/duration/magnitude of summer dry/drought periods - closely associated with higher temperatures. Furthermore, geographical and temporal nuances in precipitation patterns from west to east are projected (i.e. more pronounced wetting in the west in winter and more pronounced drying in the east during summer). All of these factors must be considered for the future expansion of non-domestic high-water users in Ireland.

Assessments of planning applications for non-domestic water users (including data centres) must consider their water requirements along with the water available for use within the catchment. They must also consider projected changes to water availability related to future climate change and projected population growth. Uisce Éireann have a pre-connection enquiry process to understand the needs of any new customer, but they do not have regulatory control over planning applications. Like all non-domestic customers, data centres pay Uisce Éireann for the water they use, so similar to electricity efficiency, there is an economic incentive for them to conserve water. Uisce Éireann have a Water Stewardship Programme[11] to help businesses lower their water use and operating costs while protecting the environment. According to Uisce Éireann, as part of the pre-connection enquiry process, they have had positive engagements on water conservation measures and technologies as part of the planning application process for new data centres.

[8] Uisce Éireann (2021). National Water Resources Plan | Projects | Uisce Éireann (formerly Irish Water)
[9] DECC (2021). gov.ie - Climate Action Plan 2021 (www.gov.ie)
[10] DHLGH (2019). Water Quality and Water Services Infrastructure - Climate Change Sectoral Adaptation Plan. dhplg_sectoral_adaptation_plan_final_en.pdf (old.gov.ie)
[11] Uisce Éireann. Water Stewardship | Conservation | Irish Water

According to a report commissioned by Cloud Infrastructure Ireland in 2022 (Baringa, 2022)[6] on a vision for sustainable data centres in Ireland, the data centre industry should:

- Align with the Climate Neutral Data Centre Pact on sustainable water use
- Meet or exceed targets as these are developed.
- Contribute to the development of additional sustainable water use metrics to modify and enhance Water Usage Effectiveness.
- Where freshwater is constrained, design new data centres to reduce strains on the water system and consider retrofitting existing data centres
- Increase use of greywater / rainwater capture to reduce freshwater use and surface water run-off.
- Increase use of water storage to reduce peak daily water usage during times of water stress.
- Optimise air vs water-cooling according to local conditions, including relative levels of water stress/abundance.
- Improve transparency around water use. E.g. publish data on performance on sustainable water use metrics, peak daily water usage, levels of storage.

Case studies – data centre water usage

Many large data centres publish their energy and water usage data in annual sustainability reports. For example, Meta (Facebook) publishes an annual sustainability report[12], which includes its annual water use at its Irish data centre. The Meta Data Centre, at Clonee, Co. Meath, has 3 large data centres over 250 acres. It is very transparent in energy and water consumption through the publication of annual sustainability reports, which includes annual water withdrawals at its facilities (Meta, 2024). Figure 1 illustrates the annual water withdrawal at the Meta Data Centre in Clonee between 2019 and 2023, which reached a peak withdrawal in 2021 of nearly 1 million m^3 (928 mega Litres), equivalent to 2.5 million litres of water per day (if withdrawn evenly over 365 days in 2021). After 2021, water withdrawal decreased again to 839 mega Litres in 2022 to 659 mega Litres in 2023, potentially indicating improvements in water efficiency at the facility. According to Facebook (*personal communication*), while the data centre is expanding, new developments have more water efficient technology, so the rate of increase in water use should not increase linearly with the number of data halls being developed.

[12] Meta (2024). 2024 Sustainability Report - Meta Sustainability

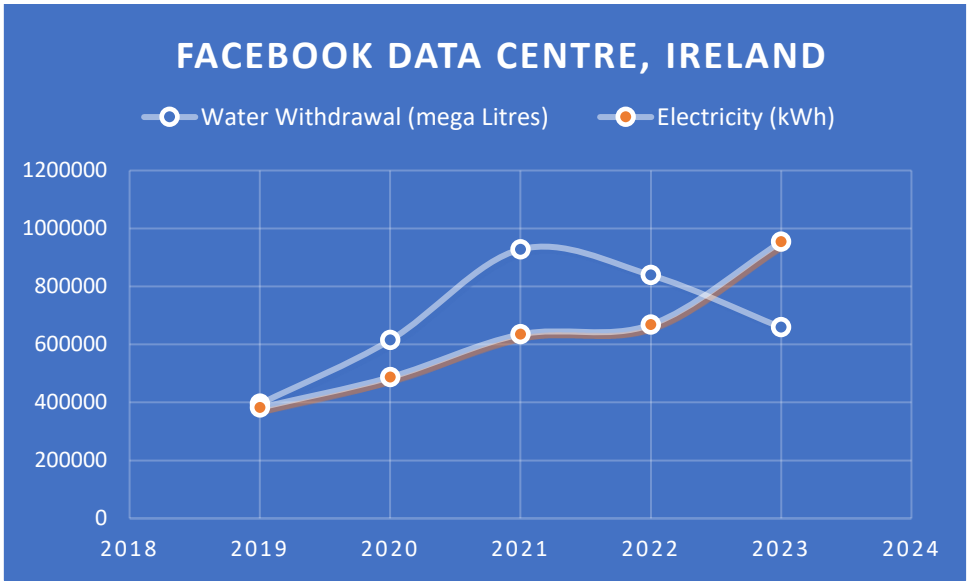

Figure 1. Annual water withdrawal (in m^3) and annual electricity consumption (in MWh) at the Facebook data centre in Ireland; values taken from Meta (Facebook) Sustainability Report 2024[12].

Google also publishes environmental data from its 23 global data centres, one of which is in Dublin. In their 2024 Environmental Report[13] water withdrawals from Google data centres (globally) increased steadily from 5,160.7 million gallons in 2019 to 8,653.3 million gallons in 2023 (equivalent to 39,337 mega litres globally in 2023). Google stated that the expansion of AI products and services is leading to an increase in data centre workloads and the associated water footprint required to cool them efficiently. In 2023, Google data centres consumed 6.1 billion gallons of water—17% more water than the previous year, mirroring similar growth in electricity use. In their 2024 Environmental Report, Google stated they have introduced a water risk framework to further identify climate-conscious cooling solutions that consider carbon-free energy availability, watershed health and future water needs

Since 2022, Google have also published their water withdrawals and water discharges for their Dublin data centre; where water withdrawals were reported as 0.6 million gallons for 2023 (2.7 million litres for 2023). Google stated they have advanced to an air-cooling system at its Dublin data centre and therefore do not require costly, power-hungry air-conditioning units. They are also installing rainwater harvesting systems there to reduce the volumes of stormwater flows in the Dublin region.

Water stewardship of data centres

With increased pressure to reduce energy requirement and meet greenhouse gas emission targets, data centres will need to consider alternative technologies to reduce their environmental footprint. While water conservation is likely low in priority relative to electricity reductions, due to the fact that cooling water is a large consumer of electricity, advancing technologies are also leading to reductions in water demands. Many of the large data centres include information on measures to reduce energy and water demand in their

[13] Google (2021). Google 2024 Environmental Report - Google Sustainability (gstatic.com)

annual sustainability reports, including water stewardship plans. Google's water stewardship projects replenished an estimated 1 billion gallons of water, which represents 18% of its 2023 freshwater consumption[13]. Microsoft have published a section called 'Water Positive' in their 2024 Environmental Report[14] highlighting their commitment to a water positive future, planning to replenish more water than they consume by 2030. Microsoft also report they are harvesting rainwater to offset water consumption at their Irish data centres.
Amazon[15] have set a goal to become water positive by 2030, aiming to return more water to communities and the environment than they consume, with a focus on reducing overall water withdrawal and replenishing water in basins facing water scarcity located in communities around data centres. While Ireland would not be considered a water stressed country, our future planning decisions must ensure that we can sustainably manage our water resources and ensure there is a resilient supply of water for both domestic and non-domestic water users.

Considerations for wastewater generated

One additional aspect of data centres and water requirements is the volumes of wastewater generated at each location. In 2021, Microsoft reported that of the total global water withdrawals, 41% of that volume was discharged to local municipal wastewater treatment facilities. Similarly, Google reported ~ 27% of its global water withdrawals were discharged as effluent. In one sense, these volumes of water are ultimately returned back to the catchment and therefore reflect a lower volume of overall water consumption. On the other hand, the impact of high volumes of water returning to wastewater treatment facilities must also be considered in planning applications. Industrial effluent from data centres would have minimal organic matter, therefore would not add additional pressure for the microbes in a wastewater treatment plant to break down. However, large volumes of even clean water have the capacity to flush out a treatment plant, similar to a flood event, generating large volumes of stormwater, which can reduce the treatment capacity within a plant and result in volumes of untreated or partially treated wastewater being discharged to the local waterbody. Furthermore, the temperature of the effluent may also influence the biological treatment at the wastewater treatment facility. While Uisce Éireann request details of wastewater effluent in their pre-connection enquiry, a review of a number of open planning applications indicated that these volumes are not included in the planning applications. Further research is required on the impact of data centre trade effluent on local waste water treatment plants.

Conclusions

Data centres are essential in today's digital world. As requirements for data centres increase globally and in Ireland, we must ensure that future expansion of this industry also considers their water requirements (along with electricity) and the impact they have on the local catchment, including water available for use and impacts on local aquatic ecosystems. There is a need for transparency in water usage and planning processes for all non-domestic, high water users in Ireland to ensure sustainable management of our water resources.

[14] Microsoft (2024). 2024 Environmental Sustainability Report | Microsoft CSR
[15] Amazon (2023). 2023-amazon-sustainability-report-aws-summary.pdf (aboutamazon.com)

References

Amazon (2023). Amazon Sustainability Report 2023. 2023-amazon-sustainability-report-aws-summary.pdf (aboutamazon.com)

Baringa (2022). Green Data: A Vision for Sustainable Data Centres in Ireland. Commissioned by Cloud Infrastructure Ireland. A vision for sustainable data centres in Ireland | Baringa

DECC (2021). Climate Action Plan 2021. From the Department of Environment, Climate and Communications, Department of the Taoiseach. gov.ie - Climate Action Plan 2021 (www.gov.ie)

DHLGH (2019). Water Quality and Water Services Infrastructure - Climate Change Sectoral Adaptation Plan. gov.ie - Water Quality and Water Services Infrastructure - Climate Change Sectoral Adaptation Plan

Eolas (2020). Data Centre Water Usage. Issue 41. Data centre water usage | Eolas Magazine

Fitzgerald (2015). Data Centers and Hidden Water Use. The Wall Street Journal. Data Centers and Hidden Water Use - WSJ

Google (2024). Google 2024 Environmental Report. Google 2024 Environmental Report - Google Sustainability (gstatic.com)

Government of Ireland (2018). Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy. gov.ie - Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy (www.gov.ie)

Government of Ireland (2022). Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy. government-statement-on-the-role-of-data-centres-in-irelands-enterprise-strategy.pdf

Meta (2024). 2024 Sustainability Report – Meta Sustainability. 2024 Sustainability Report - Meta Sustainability

Microsoft (2024). 2024 Microsoft Environmental Sustainability Report. 2024 Environmental Sustainability Report | Microsoft CSR

Myton (2021). Data centre water consumption. npj Clean Water volume 4, Article number: 11. https://doi.org/10.1038/s41545-021-00101-w

Oireachtas Library & Research Service (2024). L&RS Spotlight: Data centres and energy. No. 2 of 2024. Data centres and energy (oireachtas.ie)

Uisce Eireann (2021) National Water Resources Plan. 2.-NWRP-Framework-Plan_For-Final-Adoption_2021_05_25.pdf (water.ie)