# DATA-CENTRE IMPLICATIONS FOR ENERGY USE IN IRELAND.

*Irish Data-Centre Load Projections to 2020*

# Contents

# 1. Executive Summary

Callaghan Engineering (CE) were approached by the Irish Wind Energy Association in May 2015 and asked to compile a report to ascertain the current base load consumed by the data-centres operating in Ireland, and to predict using publically available information, combined with industry knowledge, the future growth of this base load figure through to 2020.

CE are a multi-disciplinary Engineering & Project Management Company, established in 1990 and celebrating 25 years in business this year. CE have offices in Dublin & Cork and currently have 30 permanent employees. Our business supports the Biopharma & Pharmaceutical industries, as well as medical devices, government, education & healthcare sectors. CE are also involved in the sustainable energy and the combined heat & power sectors.

Over the past 7 years, CE have been a lead player active in the design of data-centre installations for confidential clients in Ireland and mainland Europe, and during this time have designed and delivered over 30 data halls. Our roles over this period included full mechanical & electrical engineering design & specification, master-planning, shell & core design, project management, factory and site acceptance testing, commissioning & handover.

Our in-depth experience of data centre design encompassed electrical & mechanical infrastructure design, with particular focus upon resilience and electrical power redundancy and specifically the design of critical power systems utilising grid power, generated power and UPS systems. Data centre design focuses upon high reliability and lowest possible running costs (PUE: Power Usage Effectiveness = total facility energy / IT equipment energy). The design therefore aims to reduce PUE to unity, so lighting and mechanical cooling loads are minimised where possible.

Our experience in this area enables us to quantify with a high degree of accuracy the electrical capacities of other data centres based upon their supporting infrastructure and data hall floor areas.

This report will look at the current situation in Ireland and will examine existing constraints and future opportunities to encourage future growth of the digital space industry.

Finally, we will present a table showing the current key market players, their estimated existing capacities and likely future growth figures. Where possible, links and references are provided for the information contained in this report. In summary, we foresee an additional future load of over 1GW from Data-Centres in Ireland by 2020.

**Note:**

Information obtained for the preparation of this report has been sourced principally from the public domain and from other industry sources. Callaghan Engineering cannot accept any liability for the accuracy of same.

Callaghan Engineering are currently restricted under several NDAs (non-disclosure agreements) with confidential clients, and therefore any information that might compromise any such NDA is not divulged in this report.

## 2. Introduction

The data-centre industry in Ireland has seen rapid growth over the past 7 years. The majority of this growth has been in the greater Dublin area. There are a number of large data-centres located around the M50.

There are several factors which dictate why the data-centre clients locate in the greater Dublin area. These are:

1. Availability of reliable electrical power
2. Availability of a high speed fibre network with links to the USA, UK and continental Europe.
3. Availability of large vacant buildings for conversion to data-centres, at affordable prices due to the collapse of the Irish economy and subsequent impact upon property values.

In addition, the other reasons that Ireland is attractive as a base for Foreign Direct Investment Companies (FDIs) are:

- Low tax rate
- Temperate climate
- Educated and English speaking workforce
- Stability
- 'Open for Business' attitude
- Availability of Infrastructure

The rapid growth of the digital space business in Ireland has been driven primarily by FDI companies. Data Centres were being built so quickly that the existing electrical infrastructures could no longer support the electrical loads being demanded by the data halls. In many cases, existing 20 & 38 kV electrical connections had to be upgraded to 110 kV, requiring the building of several new HV substations in the Dublin area.

As the greater Dublin area approaches saturation, FDIs are looking to expand outside of Dublin in order to fulfill their growth plans. To do this, real estate, fibre connectivity and electrical power need to be present to support this growth.

New fibre connections are currently underway linking the West of Ireland to the USA and also linking Cork directly to the USA and mainland Europe. We will explore these new fibre connections later in the report.

As part of this work CE has conducted research into the Irish grid and using information from the Eirgrid website and associated links, we have ascertained areas suitable for growth and areas that are nearing maximum capacity. While there is ample capacity in the Eirgrid network as a whole to support additional data-centre loads both small scale (<10MVA) and large, scale (>50MVA) the existing infrastructure configuration may demand that these loads are spread throughout the country rather than in grid hotspots and population centres  such as Dublin and Cork.

Combined with industry knowledge, public material and research, we are confident that our projections to 2020 in the data-centre business are conservatively accurate. There may be additional loads over and above our projections within this report which we cannot divulge at this point due to existing NDA restrictions.

> *"It can be conservatively deduced that there is currently approximately 311 MWs of data-centre load on the Irish Grid on a 24/7 basis – equivalent to 7% of current winter peak load"*

## 3. Current Data-Centre Loads

There is at present a reasonable presence of data centres in Ireland, the largest of which are operated by Google, Microsoft and Amazon. In addition, Digital Realty, Telecity (Interxion / Equinix), Eircom and Citadel own and operate several other centres. Table 1 below shows the estimated installed capacities of the larger current operators.

| Operator | Estimated Installed Capacity(MW) | Location |
|---|---|---|
| BT | 10 | Dublin |
| Citadel100 / HP | 20 | Dublin |
| Confidential Client | 140 | Dublin |
| DRT | 3 | Dublin |
| Eircom | 20 | Dublin |
| CIX | 1 | Cork |
| Telecity (Equinix) | 19.5 | Dublin |
| Google | 80 | Dublin |
| IBM | 22 | Dublin |
| Interxion | 8 | Dublin |
| Microsoft | 80 | Dublin |
| EBay | Unknown | Dublin |
| Vodafone | Unknown | Dublin |
| DataPlex | 10.5 | Dublin |
| Yahoo | Unknown (leased data centre) | Dublin |
| **Total** | **414 MW** | |

*Table 1: Existing Data Centre Capacity in Ireland*

Table 1 above shows estimated installed capacity and not necessarily actual load. Applying a multiplier of 0.75 is an industry norm and a realistic figure for average loads for these centres, based upon design norms and allowance for capacity increase. Given that there are additional smaller data-centres not listed above it can be conservatively deduced that there is **currently approximately 311 MWs** of data centre load on the Irish Grid on a 24/7 basis. This is equivalent to 7% of current peak winter demand and 8.6% of summer load as per Table 2 further below.

IWEA advises that a typical Irish wind farm has a capacity factor of around 30%, so each year 1MW of wind produces around 2.6GWh. Ireland has a national target of achieving 40% of all electricity being produced by wind by 2020 (as part of a policy to meet an EU overall energy renewable energy target of 16%). Thus each additional 1MW of data centre load at 75% load factor draws 6.5GWh annually, and since 40% of that must be renewable, to all intents and purposes, each new 1MW of data centre growth will need to be matched with 1MW of wind farm capacity. Wind and data centres make natural partners, since data centres flat demand profile lifts the minimum night time demand, and this reduces the cost of integrating wind in

the Irish market, bringing savings to consumers. In the future, if data centre demand can become more price responsive, this will further ease the matching of the variable wind output to demand. It is also relevant to note that recent data centres and large demand locating in Ireland (such as Apple, Facebook and IKEA) have as part of their announcements publicly committed to sourcing 100% renewable power for their facilities. Similar announcements to secure power from renewable energy have also emerged in the food and pharmaceutical industry globally and also here in Ireland. This is in turn is being driven by demand from the consumers of their services. **As set out in Table 2 below, there's a minimum of 1136MW of additional data-centre capacity outlined within this report. This represents an approximate 18% increase in electricity demand. At a conservative investment level of €3.25m per MW of data-centre capacity, the minimum expected investment stemming from projected new data-centres is €3.7bn to 2020.**

While it is not entirely clear how this will be achieved given the pooled nature of the Irish electricity market and the details of how the REFIT scheme is implemented, the underlying trend is clear, and could in time also drive renewable energy development along with national renewables targets and support schemes.
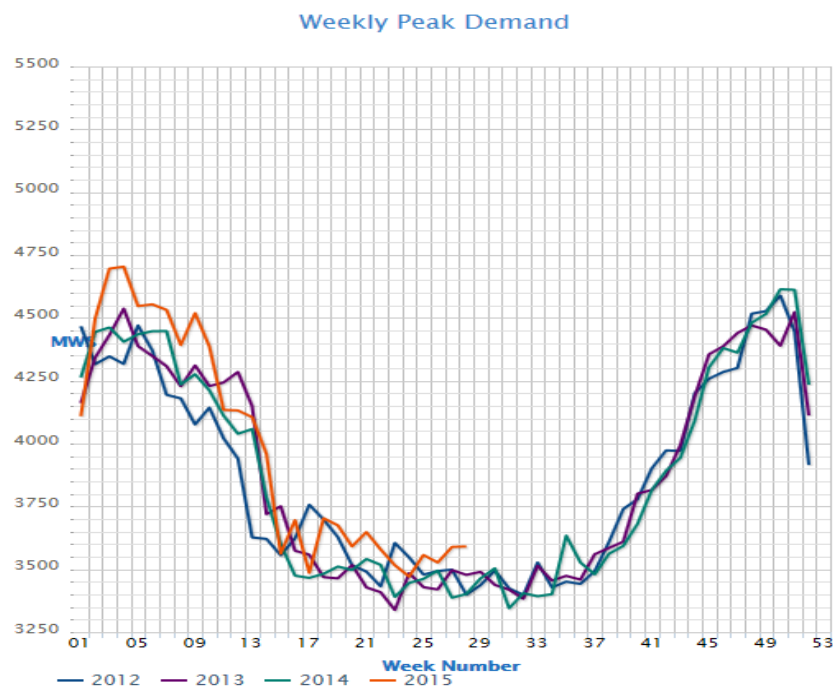


*Figure 1: Republic of Ireland load Profile*

## 4. Ireland's Fibre Infrastructure

The fibre infrastructure in Ireland is currently centered in the Dublin area. The fibre companies are aware of global trends in data traffic and are investing heavily in Ireland to cater for this growth. (CAGR – Compound Annual Growth Rate)



Sources: AV&Co. Research and Analysis, FCC, Akamai, Cisco VNI , Nielsen, SNL. comScore, Cisco
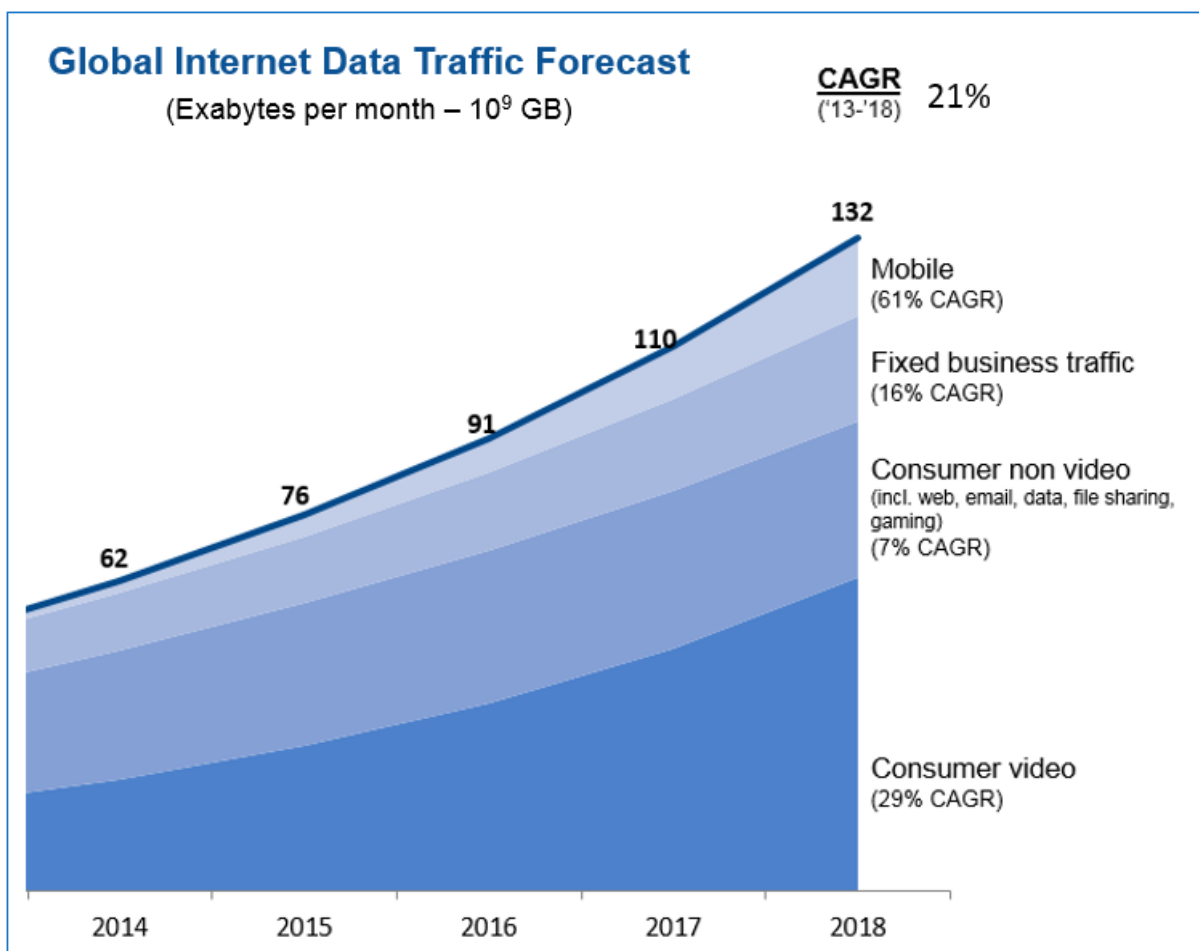
Ireland is an ideal hub for transatlantic cables and can be used to route directly to the UK and mainland Europe.

'Arctic Fibre' will be bringing a new cable from Prudhoe Bay (Alaska) to Europe in 2018 and will 'tee' from this cable into Ireland via Cork. This new cable will connect Japan – Alaska – Canada – Western Europe with the shortest direct route. (Shorter routes give lower latencies, meaning higher speeds)

Similarly 'Hibernia' (one of the current fibre providers in Ireland) are bringing a new cable from the US directly to Ireland and on to London & Europe. The new Hibernia link will come ashore in Cork and link directly to Dublin with a new 6-pair system, designed to provide > 53Tb with diversity and scalability
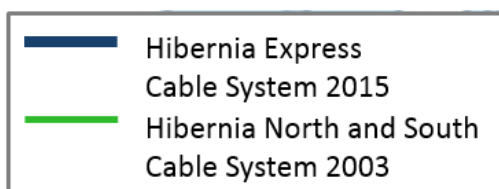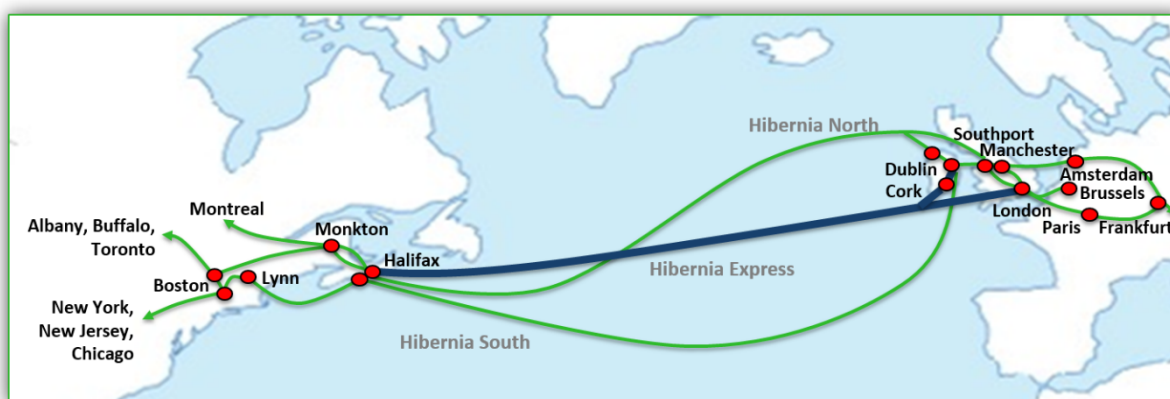


The IFSC project (Ireland France Subsea Cable) will connect Lannion in France to the Cork Internet Exchange (CIX) and will be a primary PoP (point of presence / hub). From here dark fibre connections will be available to Dublin via multiple redundant routes. This will give a direct route to Europe bypassing London which improves transmission speed.

Given that such investment is already underway, it is clear that there is intent to utilize this additional data capacity. Because Ireland is an ideal hub (meteorologically, geographically and infrastructurally), FDI companies are intending to exploit this fact.

Note also that the Cork Internet eXchange (CIX) will become the EU data centre with lowest latency to North America. This coupled with available real-estate, lower rents and available electrical power highlight Cork as a future investment location for FDIs and large data centres.

# 5. Electrical Infrastructure

Ireland has one of the most robust, reliable and stable grid systems in Europe. It also has a predictable repeatable load profile for a developed country, showing reduction by night and peaks during the working day.

During the day the average load is approximately 4.4 GW. There is currently capacity on the system for more than 6.5 GW with further capacity increases planned under EirGrid's 'Grid25' plan.

The infrastructure is centered on the Dublin area (largest population centre) and as Dublin is used a switching hub, it is therefore heavily loaded in that area. Therefore, remaining power for future data centres in Dublin is limited (without further investment by EirGrid).

Consequently, a large shift outside of the Dublin area is forecast. While EirGrid could not give us specific information, they did confirm that there have been several large applications made for new datacenter connections. These applications are of a serious nature by FDIs and not of a speculative type.

It was confirmed also that both Cork & Limerick are earmarked for future data-centre locations. Currently Cork has the capacity to support up to 500 MW of data-centre load.

EirGrid expect an additional 1GW of data-centre base load by 2020, and this will be substantiated in a report expected to be published in Q3, 2015.

# 6. Future Data-Centre Load Projections

An examination of the market based on existing client, market intelligence and publically available information allows us to project additional capacity that is expected to be connect to the Irish power system over the next 5 years. It should be noted that data centre load is modular and can be installed at a rate that is unlike the normal load growth of manufacturing industries.

| Operator | Estimated **Current** Installed Capacity(MW) | Projected **Additional** Capacity (MW) | Probability (Low/Med/High) | Location | Ref Number |
|---|---|---|---|---|---|
| Apple | 0 | 300 | High | Athenry | 1 |
| BT | 10 | 30 | High | Dublin | 2 |
| Citadel100 / HP | 20 | Unknown | N/A | Dublin | 3 |
| Confidential Client 1 | 140 | Unknown | Unknown | Dublin | N/A |
| Confidential Client 2 | Unknown | 360 | High | Outside Dublin | N/A |
| DRT | 3 | 12 | High | Dublin | 4 |
| Eircom | 20 | 120 | Medium | Dublin | 5 |
| EMC | 0 | 16 | High | Cork | 6 |
| Telecity (Equinix) | 19.5 | 6.5 | High | Dublin | 7 |
| Interxion | 8 | Unknown | Unknown | Dublin | 8 |
| Facebook | 0 | 46 | High | Clonee | 9 |
| Google | 80 | 120 | High | Dublin | 10 |
| IBM | 22 | Unknown | Unknown | Dublin | 11 |
| Microsoft | 80 | 125 | High | Dublin | 12 |
| EBay | Unknown | Unknown | Unknown | Unknown | N/A |
| Vodafone | Unknown | Unknown | Unknown | Unknown | N/A |
| Data Plex | 10.5 | Unknown | Unknown | Dublin | 13 |
| Yahoo | Unknown | Unknown | Unknown | Dublin | 14 |
|  |  |  |  |  |  |
| **Total** | **414** | **1136** |  |  |  |
| **Load Factor of 75%** | **311** | **852** |  |  |  |

*Table 2: Existing and Projected Additional Data Centre Capacity in Ireland*

There may be other smaller data-centres under consideration not shown within Table 2. However the "unknowns" in the list above are all expected to be in the 10MW+ range, with some possibly in the 50MW+ size.

# References

| Ref | Client | Link | Comment |
|---|---|---|---|
| | | | |
| 1 | Apple | http://www.irishtimes.com/business/retail-and-services/apple-seeks-green-energy-projects-to-power-850m-galway-data-centre-1.2192569 <br> http://www.idaireland.com/newsroom/blog/2015/06/02/irelands-data-centre-boom/ | IDA & Irish Times |
| 2 | BT | http://www.btireland.com/prodserve_btcompute.shtml?gclid=CPD-sfmPgsYCFaOy2wod6q0Aqw | 183000 ft2 CityWest ~ potential for 40MW. (17000m2 @ 2.5MW per 1000m2 approx.) |
| 3 | Citadel / HP | http://citadel100.com/infrastructure/power-and-cooling/ | |
| 4 | DRT | http://www.businessandleadership.com/business/item/47628-digital-realty-trust-opens <br> http://www.independent.ie/business/irish/digital-realty-trusts-ireland-30594723.html | 16MW total |
| 5 | Eircom | http://www.citadel100.com/blog/?p=376 | 20MW capacity in Clonshaugh (leased from DRT- MIC of 20 MVA @ 110kV). €200M, 473,000 ft2 planned for Clondalkin |
| 6 | EMC | http://www.irishexaminer.com/business/emc-applies-for-planning-to-build-cork-data-centre-303489.html <br> http://maps.corkcoco.ie/planningenquirylitev3/Default.aspx?FullFileNumber=18a-146757&FromList=true | New building at existing facility in Ovens, Cork. Planning ref 146757 |
| 7 | Telecity | https://www.siliconrepublic.com/careers/2015/02/23/new-telecitygroup-data-centre-to-open-in-dublin-with-10-jobs <br> http://www.citadel100.com/blog/?p=1578 | 3 existing DCs (assuming 6.5MW each), 1 new 2500m2 centre (6.5MW) proposed for Blanchardstown |
| 8 | Interxion | | Industry Sources ( UPS & |

| | | | Generator Suppliers |
|---|---|---|---|
| 9 | Facebook | https://www.siliconrepublic.com/enterprise/2015/05/19/facebook-plans-e200m-data-centre-for-meath-begins-recruiting-engineers | €200M (200,000 ft2) 18500m2 @ 2.5MW per 1000m2 |
| 10 | Google | http://www.independent.ie/business/irish/google-to-build-new-150m-data-centre-in-dublin-30012987.html | 80MVA Substation exists (industry info). Grid application made for 120 MVA – not yet secured (via industry sources) |
| 11 | IBM | | Based upon industry sources of installed equipment ( UPSs & Generators) |
| 12 | Microsoft | http://www.citadel100.com/blog/?p=1760 http://www.citadel100.com/blog/?p=1597 http://www.citadel100.com/blog/?p=248 | 2 x Grid applications ( 45MVA & 80 MVA) for Grangecastle extension & new Leopardstown site (via industry sources) |
| 13 | DataPlex | http://www.dataplex.ie/#our-data-centres | 7000 m2 with 1500W/m2 power density. Blanchardstown |
| 14 | Yahoo | http://www.dataplex.ie/#our-data-centres | Leased data centre in Dublin. May build their own. |