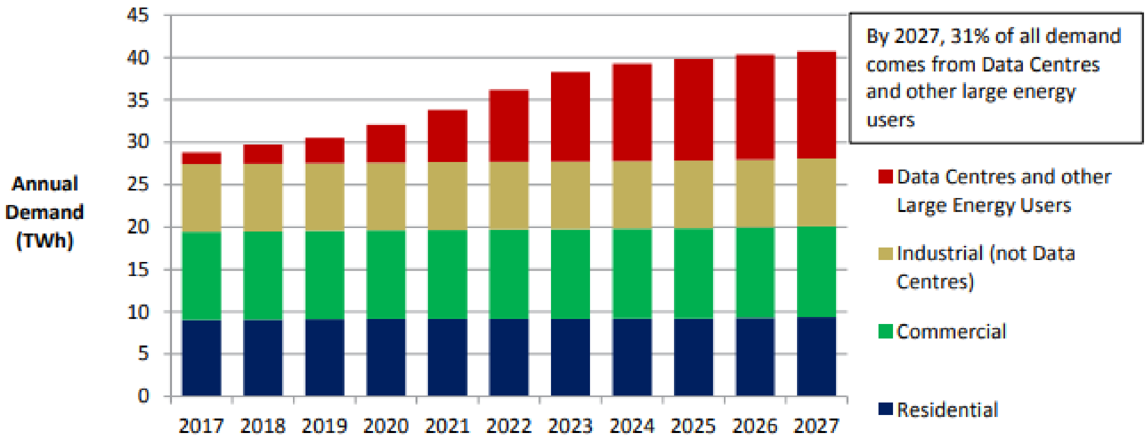
Electricity Sector Investment for Data Centres in Ireland

Data Centre Electricity Demand Projections

Eirgrid's 2018 Generation Capacity Statement highlights that the projected future growth in Ireland's electricity demand is wholly due to data centre demand and expansion by a very small number of large industrial customers as illustrated in the chart below[1].



This is because the anticipated improvement in appliance efficiency in other sectors is projected to compensate for the impact of forecast economic and population growth and moves to increased penetration of electrically powered heating and transport.

Additional Renewable Electricity Requirement

It is assumed that 70% of the additional 12.5 terawatt hours (TWh)[2] of electricity demand arising from these developments is sourced from renewable generation i.e. 8.75 TWh by 2030 in line with the Government's Climate Change Action Plan, with almost all the balance being produced from high-efficiency gas-fired turbines. This will require a very considerable additional investment in renewable electricity generation and in the transmission and distribution networks. The calculation of the required level of investment depends on assumptions as to how this renewable electricity is powered. The Academy's assumptions and cost calculations are included in Appendix 1. For the purposes of this analysis, we are assuming that 50% is sourced from onshore wind, 25% from offshore wind and 25% from solar PV.

Additional Dispatchable[3] Generation Requirements

With the assumption that 70% of the additional annual electricity will be sourced from renewables, there will be a requirement for additional thermal generation to meet the electricity requirement at times of low wind and solar electricity output. As data centre

[1] Extract from Eirgrid Generation Capacity Statement 2018 (Median Demand Scenario).
[2] For explanation of technical terms and units see Appendix 2.
[3] Dispatchable generation refers to sources of electricity that can be used on demand and dispatched at the request of power grid operators, according to market needs. Dispatchable generators can be turned on or off, or can adjust their power output according to an order.

electricity demand is relatively flat, the projected increase in peak demand between 2018 and 2027 is 1,300 megawatts (MW).

Eirgrid assume that wind generation contribute 10.5% of rated capacity at peak demand periods and solar PV 5.5%. With these assumptions, the requirement for additional dispatchable capacity falls to a little less than 950 MW. For the purposes of this analysis it is assumed that all of this is provided independently. However as almost all data centres are equipped with standby generation to cover for network outages, there is a valid argument that this capacity should be dispatchable, thus avoiding duplicate investment.

In practice some data centre operators generate all the time; others, who wish to portray their operations as being based on renewable electricity, do not seek the licences to enter the electricity market that dispatchable operation requires. There is a need for a realistic approach to this issue to avoid unnecessary capital expenditure.

Generation Capital Cost Assumptions

The capital investment requirements for wind and solar powered generation are those quoted in the WSP Parsons Brinckerhoff[4] study prepared for the Department of Communications, Climate Action & Environment and include network connection costs. The other capital cost assumptions are the same as those used by Baringa[5] in their 70 by 30 report for the Irish Wind Energy Association.

Incremental Generation Capital Investment Requirements

These are computed in the table in Appendix 1.

The conclusion is that the projected development of data centres in Ireland would necessitate an incremental investment in the electricity sector in Ireland of almost €6 billion in generation and associated network assets.

Incremental Investment Required for Storage

Clearly renewable generation from intermittent and uncontrollable sources such as wind and solar cannot provide reliable continuous power. Thus, to reduce the requirement for thermal generation and to minimise incremental emissions, it is further assumed that storage capacity equivalent to one day's data centre demand is provided, to help reduce thermal generation requirements, when the wind does not blow or the sun does not shine. This could be provided by battery or pumped hydro storage but more likely by a combination of both. However, for financial analysis purposes it is assumed that it will all be provided by battery storage.

It is further assumed that battery costs[6] will halve by 2030. Thus, the incremental cost for providing 34 GWh of battery storage is estimated at approximately €2.5 billion, excluding network connection costs. Thus, total investment requirements to provide the required increase in generation and storage capacity is estimated at almost €9 billion.

[4] https://www.dccae.gov.ie/en-ie/energy/consultations/Documents/28/consultations/Renewable
[5] www.iwea.com/images/files/70by30-report-final.pdf
[6] Bloomberg New Energy Finance

Incremental Investment for Transmission and Distribution System Reinforcement.

Eirgrid's analysis indicates that significant additional reinforcement of the transmission grid will be required to support the projected data centre development, particularly in the Greater Dublin Area. This will include the development of a 400kV circuit from Woodland to Dunstown and at least three other circuits, some or all of which may be both controversial and difficult to execute. The addition of 4500 MW of renewable generation, to meet 70% of projected data centre electricity requirements, will also involve significant, but at present unquantifiable network reinforcement costs.

Furthermore, the regulatory capital recovery period for Transmission and Distribution assets is 50 and 40 years respectively. Given the uncertainty as to how data centre requirements and technology will develop in a much shorter period the recovery of network reinforcement assets, to support data centre development, is clearly an additional risk factor for electricity consumers.

Increase in Carbon[7] Emissions

As 30% of the projected data centre electricity demand is assumed to be produced from thermal generation this will result in significant additional carbon emissions. For the purposes of this analysis it is assumed that this generation will be predominantly supplied from highly efficient gas -fired combined cycle gas turbine units, but emissions could be significantly higher if the use of oil fired open cycle gas turbines is necessary. On the basis of these assumptions data centre development is projected to add at least 1.5 million tonnes to Ireland's carbon emissions by 2030 – about a 13% increase on electricity sector emissions[8] at present.

Conclusions

The establishment of Ireland as the data centre capital of Europe clearly brings considerable direct investment in the data centres themselves, many of which are linked to the operations of major multinational employers, who have much of their non-US business serviced from Ireland. However much less attention has been paid to the very considerable investment in generation and network assets required to such a large-scale development of data centres in Ireland.

The issue of who will pay for this investment and how it will be funded urgently needs analysis and debate, as does the potential future development of the data industry itself, given the projected investment requirement will be almost €9 billion by 2027 to provide the required power supply to support its development. The Government Statement on the "Role of Data Centres in Ireland's Enterprise Strategy" recognised this exposure but to date no measures have been put in place to ensure that these costs are fully borne by data centre developers.

[7] Carbon Dioxide (CO_2)
[8] CO_2 emissions from electricity amounted to 11.7 million tonnes in 2017 (SEAI Energy in Ireland Report 2018)

Appendix 1: Additional Electrical System Investment

	Scenario[1]	Capital Cost	Investment (€ million)
Data Centre System Demand (TWh)	12.5		
TER Peak (Gigawatts)	1.3		
Renewable Generation Requirement TWh	8.75		
Onshore Wind - 50%	4.375		
Offshore Wind - 25%	2.1875		
PV Generation - 25%	2.1875		
	8.75		
Renewable Generation Requirement MW		**€m/MW [2, 3]**	
Onshore Wind, 28.5% capacity factor [3]	1752	1.475	2585
Offshore Wind, 45% capacity factor [4]	555	3.08	1709
PV Generation, 11% capacity factor [5]	2270	0.79	1793
	4577		6087
Renewable Generation Availability at Peak			
Wind %	10.3		
PV %	5.5		
Conventional Generation Requirement (MW)	937		
Open Cycle Gas Turbine Requirement [5]	937	0.37	347
		€m/GWh [6]	
Electricity Storage, 1 Day Demand (GWh)	34	70	2380
Total Investment Requirement (€ million)			**8814**
CCGT CO2 Emission Rate (tonnes/MWh) [7]	0.4		
Increase in CO2 emissions (million tonnes)	1.5		

Notes
1. Eirgrid's Generation Capacity Statement 2018 – Median Growth
2. WSP (Parsons Brinkerhoff) Report for DCCAE
3. Eirgrid GCS 2018
4. Baringa 70 by 30 Report for IWEA
5. Eirgrid GCS 2018 and Baringa 70 by 30 report
6. Bloomberg New Energy Finance
7. Assuming almost all additional thermal generation produced from gas-fired CCGT's

Appendix 2 Glossary of Terms

Acronym/Abbreviation	Term	Explanation
CCGT	Combined Cycle Gas Turbine	A type of thermal generator that typically uses natural gas as a fuel source. It is a collection of gas turbines and steam units; where waste heat from the gas turbines(s) is passed through a heat recovery boiler to generate steam for the steam turbines.
GW	Gigawatt	Unit of Power 1 Gigawatt = 1,000,000 kilowatts
GWh	Gigawatt hour	Unit of energy 1 Gigawatt hour = 1,000,000 kilowatt hour
MW	Megawatt	Unit of Power 1 Megawatt = 1,000 kilowatts
OCGT	Open Cycle Gas Turbine	
PV	Photovoltaic	
TER	Total Electricity Requirement	
TWh	Terawatt hour	Unit of energy 1 terawatt hour = 1,000,000,000 kilowatt hours