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ENERGY POLICY &
MODELLING GROUP

Data centres in the context of Ireland's carbon budgets

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Coláiste na hOllscoile Corcaigh

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About this study

This study was commissioned by Friends of the Earth Ireland and undertaken by Prof. Hannah Daly. It seeks to explore and analyse the evidence surrounding the impact that growing data centre energy demand is having on Ireland's electricity and natural gas usage, greenhouse gas emissions and legally-binding carbon budgets.

Executive summary

This report explores the implications of rapidly increasing data centre electricity demand on Ireland's carbon budgets and broader decarbonisation commitments. As of 2023, data centres accounted for 21% of Ireland's electricity consumption, a figure projected to rise significantly by 2030. This unprecedented growth is matching the deployment of renewable energy, contributing to a stagnation in Ireland's progress toward reducing greenhouse gas (GHG) emissions and meeting legally-binding carbon budgets.

Key findings include:

- Electricity demand from data centres has grown at an annual rate of 22.6% since 2015, compared to 0.4% for other sectors. Without data centres, Ireland's electricity demand would have seen minimal growth over the past decade. Instead, demand between 2012 and 2022 grew by 24.7%, the second-fastest rate in the EU, while electricity demand in the EU fell by 3.1%. By 2027, data centres are projected to use more electricity than all households use today, and under high-demand scenarios are projected to exceed the demand of all sectors by 2025.
- Between 2017 and 2023, all additional wind energy generation in Ireland was absorbed by data centres. As data centre demand has expanded at the same rate as renewables generation, renewables are not delivering net reductions in fossil fuel use in power generation. Electricity demand from data centres far outstripped the additional renewable energy being procured through CPPAs between 2020 and 2023, and the proportion of CPPAs undertaken by data centres is itself unknown.
- Dozens of data centres have secure or are seeking connections to the natural gas network to overcome local power network constraints. On-site generation of electricity with natural gas less efficient than grid-scale generation, further increasing emissions intensity, and will sustain fossil fuel demand. Current national energy demand and GHG projections underestimate the impact of gas demand, as emissions from on-site generation are not fully accounted for, creating a significant blind spot in Ireland's climate action planning. The potential scale of demand from data centres who have made formal enquiries to connect to the gas network is large, but highly uncertain: if gas connections were temporary, data centres used them for a very small percentage of time, and switched to 100% renewables supply as quickly as possible, the risk would be minimal. However, it is not clear whether this outcome is realistic given the current extraordinary pace of growth.
- Data centres are driving additional GHG emissions from both electricity and natural gas consumption, threatening carbon budgets.
- Biomethane has been proposed as a mitigation strategy but the scale of demand for data centres would exceed sustainable production capacities and is unlikely to meet demand without diverting resources from critical sectors like heating and heavy industry, undermining its decarbonisation potential.
- Ireland lacks real-time emissions data for data centres, hindering accurate assessments of their climate impact. Moreover, the shift to on-site gas generation transfers energy security risks to the gas network, creating vulnerabilities in an already constrained system and creating the risk of fossil fuel lock-in.

This report **concludes** that unchecked data centre growth poses a significant threat to Ireland's climate commitments. Without decisive action, data centres will continue to divert renewable energy to serving demand growth rather than displacing fossil fuels, deepen reliance on fossil fuels, and exacerbate Ireland's carbon budget overshoot and energy security threats. A comprehensive policy framework is urgently needed to ensure Ireland's economic development and enterprise strategy are aligned with legally-binding climate commitments.

Policy recommendations include:

- Enforce stricter power and gas grid connection policies for data centres, requiring alignment with carbon budgets
- Enhance transparency and research, by mandating real-time GHG emissions reporting for data centres and improve data collection on gas usage and renewable energy procurement, to allow a full assessment of the current and potential future GHG impact of data centres.
- Develop a national electrification strategy to accelerate the electrification of transport, industry and heating, ensuring that renewables primarily displace fossil fuels. Create a plan for the use of surplus renewable energy production that best serves climate and societal goals, that is not limited to serving data centre needs, if and when this surplus arises. For example, this could entail delivering deeper climate mitigation, such as in aviation fuels, green fertiliser, Direct Air Capture and synthetic proteins.

Context & background

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Background: Global context

Data centres are shaping global energy markets

- The rapid growth in data centre operations across the world is raising concerns that rising power demand will set back progress in cutting greenhouse gas emissions. In the United States, for example, 133 new gas-fired power plants, four oil-fired plants and two coal-fired power plants are being developed because, after a period of stable power demand, power consumption is suddenly and rapidly growing due to a surge in data centre energy use[1]. This surge in demand is also leading to investments in additional fossil fuel infrastructure, and therefore dependence on natural gas supply, including pipelines and liquefied natural gas (LNG) infrastructure.
- Increasing investment in natural gas generation capacity and infrastructure is threatening to lock in fossil fuel use. For example, across Europe, 80.1 GW of new gas-fired power generation capacity is under construction or planning[2], without concrete commitments and actions to remove fossil fuels from power generation by 2035, which is a necessary milestone under the International Energy Agency's (IEA) Net-Zero by 2050 study. Meanwhile, gas, mainly LNG, is powering the booming growth of data centre demand across Asian countries.[3]
- Until recently, increasing energy demand arising from data centres was largely replacing the processing power of smaller-scale processing on servers and personal computers: efficiency improvements associated with large-scale data centres had been offsetting the majority of additional demand due to demand growth, leading to only moderate overall growth in electricity demand. The IEA estimated that global data centre electricity consumption in 2022 was around 1-1.3% of total global electricity demand (excluding electricity for cryptocurrency mining) [4].
- However, despite continued efficiency gains, the rapid growth in data centre investments and workloads has resulted in substantial annual increase in energy use, growing by 20-40% annually globally. This has mainly been driven by a boom in artificial intelligence (AI), and is likely to continue over the coming years, with the IEA projecting that overall electricity demand from data centres could double between 2022 and 2026, depending on efficiency improvements and the outlook for AI[5] . This increase is equivalent to the entire power consumption of Germany.
- This emerging trend has led to concerns on the upward pressure data centres are placing on decarbonisation. Global electricity demand is forecast to grow by around 4% in 2024, which is the highest annual rate since 2007, and grow by 4% again in 2025[6]. While renewable electricity generation is also growing strongly, its growth is not yet strong enough to overtake growth in electricity demand and cause an absolute reduction in fossil fuel use, and greenhouse gas emissions, in global electricity generation – much less to make emissions fall in line with the very rapid trajectory necessary.
- While the IEA projects that greater electricity demand is to arise from other sectors including EVs, industry and buildings, in many of these cases electricity demand is replacing fossil fuel usage, and therefore improves overall efficiency and cuts greenhouse gas emissions. Moreover, the IEA acknowledges deep uncertainty on the future speed and scale of AI growth, with generative AI applications being adopted faster than other innovations such as the personal computer. [7]
- The rise of AI suggests a new era of electricity demand growth, which may only be limited by the ability of physical networks and new power generation capacity to accommodate them. This – and evidence showing that the growing capacity of renewables is insufficient to meet rising demand (at least in the short- to medium-term) suggests that binding climate policies will be necessary to keep growth in line with decarbonisation commitments.

[1] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/us-has-133-new-gas-fired-plants-in-the-works-putting-climate-goals-at-risk-81469493
https://www.reuters.com/technology/artificial-intelligence/how-ai-cloud-computing-may-delay-transition-clean-energy-2024-11-21/
[2] https://drive.google.com/file/d/1xVFAZoGefPhfuilcLiiTrcwQ7lCOcOEH/view
[3] https://www.woodmac.com/news/opinion/will-gas-fuel-asias-data-centre-boom/
[4] https://www.iea.org/commentaries/data-centres-and-energy-from-global-headlines-to-local-headaches
[5] https://iea.blob.core.windows.net/assets/6b2fd954-2017-408e-bf08-952fdd62118a/Electricity2024-Analysisandforecastto2026.pdf
[6] https://www.iea.org/news/global-electricity-demand-set-to-rise-strongly-this-year-and-next-reflecting-its-expanding-role-in-energy-systems-around-the-world
https://www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector

Data centres in Ireland

- Ireland's position as a European data center hub has attracted significant investment but is now facing major challenges in meeting the growth in demand while decarbonising energy supply rapidly, in line with legislated carbon budgets. Electricity consumption from data centres grew by 20% between 2022 and 2023, and represented 21% of total electricity demand in 2023[1]. According to the Sustainable Energy Authority of Ireland, "*the scale of energy consumption growth from datacentres is likely to significantly eclipse the electricity consumption growth of any other sector*".
- Around €15 billion has been invested in data centres in Ireland, according to Bitpower[1], with two thirds of this invested by "hyperscale" operators Amazon Web Services, Microsoft, Meta, and Google. Another nine companies account for the remaining €5 billion, including Echelon, Keppel DC Reit, and Vantage
- In 2021, Ireland's Commission for Regulation of Utilities (CRU) noted that "*there is an evolving, significant risk to electricity security supply in Ireland. A significant contributory factor to this risk is a large increase in electricity demand presented by the growth of the data centre industry*"[2].
- Moreover, according to the Sustainable Energy Authority of Ireland,
  - *In the context of our legally binding national and international climate and energy obligations, the negative consequences versus the benefits of allowing new large electricity users, such as datacentres, to establish in Ireland needs to be considered. If the scale and pace of renewable energy growth cannot exceed that of electricity demand, as was the case in 2023, then renewables are just abating further increases in emissions rather than delivering the absolute reductions in greenhouse gas emissions required.*[3]
- Proponents of data centres in Ireland argue that data centres are supporting Ireland's climate goals, because they are sparking greater demand for renewable energy[4]. Central to this narrative is that not only is the expansion of data centres essential for Ireland's economic prosperity, but this is also compatible with – or even necessary for - Ireland's decarbonisation, as "*data centre owners have been to the forefront of commissioning and paying for clean energy*". However, there is a significant absence of evidence-based analysis to establish the extent to which the concentration of data centres in Ireland are working for, or against, Ireland's legally-binding carbon budgets.
- **The purpose of this report** is to examine and analyse the evidence in relation to this question.
- This issue is arising in Ireland now given the concentration of data centres in a relatively small power system, but this issue is likely to become prominent in other countries which face bottlenecks in renewables and strong growth in demand. Therefore this subject should have broader interest outside of Ireland.

[1] https://www.cso.ie/en/releasesandpublications/ep/p-dcmec/datacentresmeteredelectricityconsumption2023/keyfindings/
https://www.businesspost.ie/news/92-data-centres-using-21-per-cent-of-irelands-electricity/
[2] https://cruie-live-96ca64acab2247eca8a850a7e54b-5b34f62.divio-media.com/documents/CRU21124-CRU-Direction-to-the-System-Operators-related-to-Data-Centre-grid-connection-.pdf
[3] https://www.seai.ie/sites/default/files/publications/National-Energy-Projections-Report-2024.pdf
[4] https://www.irishtimes.com/business/2024/10/14/instead-of-curbing-data-centres-we-should-build-more-to-spark-greater-demand-for-renewable-energy/
https://www.businesspost.ie/analysis-opinion/matt-cooper-data-centre-limits-and-airport-passenger-cap-are-acts-of-self-sabotage/

Energy demand growth

To what extent have data centres been driving energy demand growth, and how will this change in the future?

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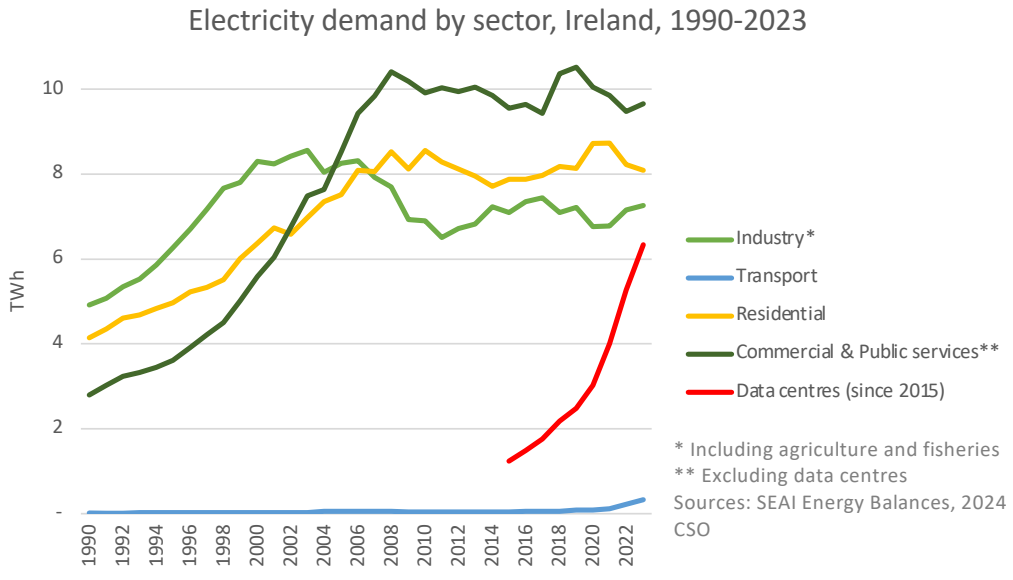
Past energy demand growth from data centers

- Since 2015, data centres have accounted for the largest share of energy demand growth in Ireland.
  - Between 2015 and 2023, total electricity demand grew by 2.6% annually. Of this, data centre demand grew by 22.6% annually, while demand in all other sectors (industry, transport, residential and commercial and public services), grew by 0.4% annually.
  - Without data centres, Ireland's electricity demand would have been relatively stable. Instead, demand between 2012 and 2022 grew by 24.7%, the second-fastest rate in the EU, while electricity demand in the EU fell by 3.1%[1]. Data from the EU demonstrate that this difference is not explained by greater consumption – electricity consumption by households in Ireland was stable over this period.

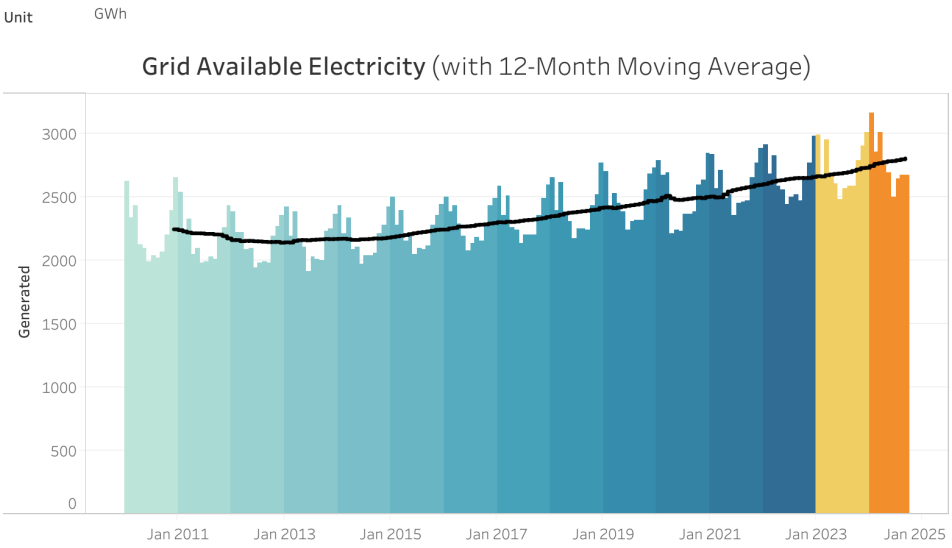


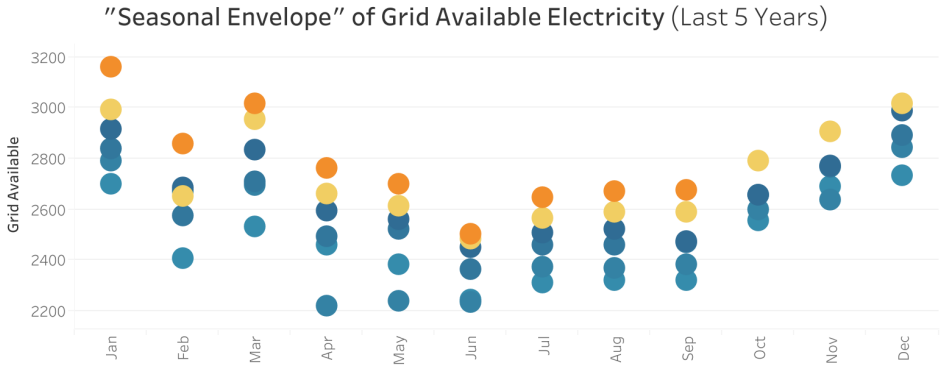
[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_production,_consumption_and_market_overview

Electricity demand in 2024

- Electricity demand in 2024 continues to grow strongly.
  - In the year to September, the electricity available to the grid* grew by 3.6% relative to the same period in 2023. Increases are being met by increased net imports from Great Britain, which are at historically high levels, while indigenous production has decreased relative to 2023.
  - Peak demand also continues to grow on the Irish electricity grid. Peak demand exceeded 7 GW for the third time in November 2024, with demand this year well ahead of previous years.

*This is an indication of consumption, which comprises indigenous electricity generation, net imports through interconnection and net pumped storage

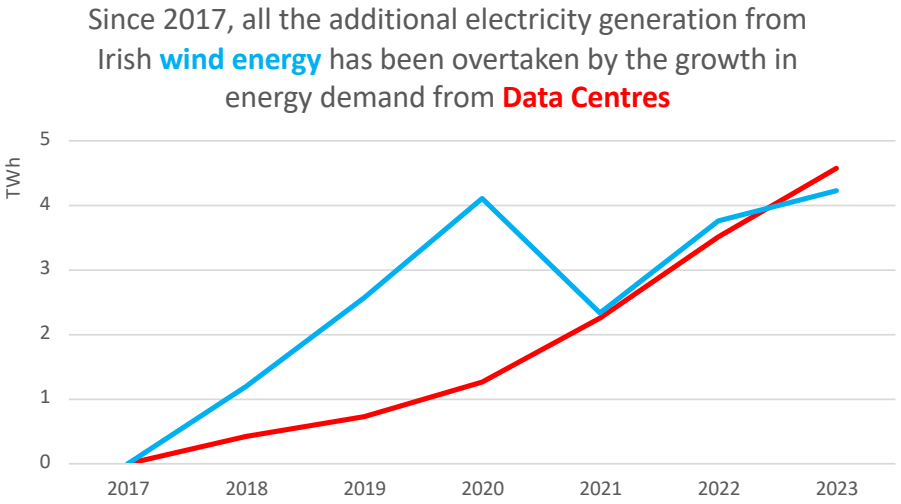




Source: EirGrid, SEAI Monthly electricity demand

Data centres and wind energy demand growth

- To analyse the claim that that greater electricity demand from data centres is accelerating decarbonisation, there would have to be evidence that renewable energy deployment is growing faster (or can grow faster) than energy demand growth from data centres, and net renewables growth is greater than what it would be without data centres. This is because it is cumulative emissions that matter for the climate and the legal carbon budget basis for Ireland's Climate Act – building renewables is only a means to achieve the goal of cutting cumulative fossil fuel use, and therefore carbon dioxide emissions, to meet carbon budgets. If growing renewables generation is simply met by growing demand, then fossil fuel use won't fall – it will be like walking up a downwards-moving escalator.
- When we look at the historical data and projections, there is no evidence to suggest that data centres are supporting net renewables growth in this way. In the figure to the right, additional wind energy generated in Ireland is charted against demand growth from data centres since 2017. Data centres have more than matched all the growth from wind energy.
- For this reason, the share of renewables in Ireland's power generation mix has remained stable over this time period, and the generation from fossil fuels has not fallen.

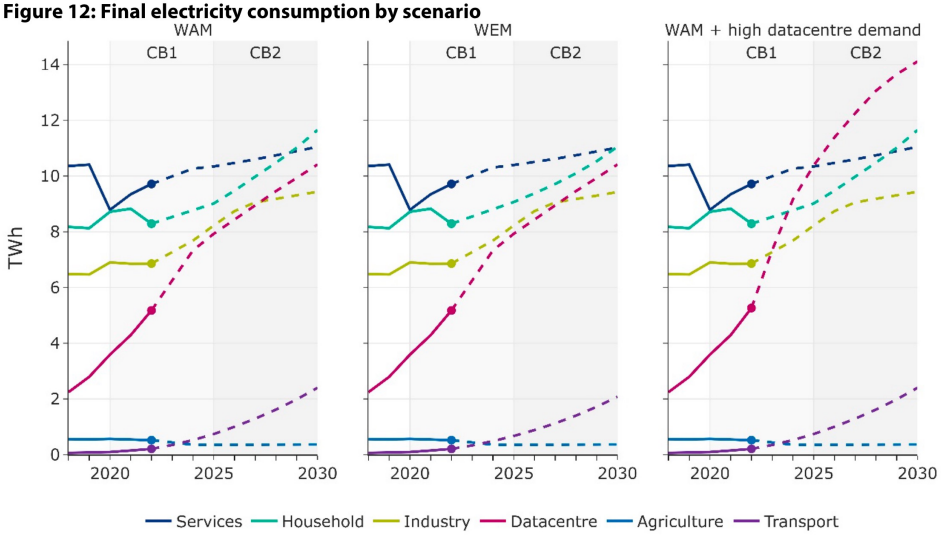


Data Sources:
- Additional data centre demand: CSO Table MEC02
- Growth in wind energy: SEAI Energy Balances, 2023

Projected data centre growth

- The Sustainable Energy Authority of Ireland (SEAI) has projected future electricity demand growth in each sector, under scenarios with existing and more ambitious climate policies (WEM and WAM respectively), and a sensitivity case with higher data centre demand (right). By 2027, data centres are projected to use more electricity than all households use today, and under high-demand scenarios, are projected to exceed the demand of all sectors by 2025.
- According to the SEAI[1],
  - *"From a national greenhouse gas emissions perspective, increased electricity demand from replacing fossil fuel heating systems with heat pumps or fossil fuelled cars with EVs results in an overall net reduction in emissions. This is because the emissions from the increased electricity demand are more than compensated for by a reduction in emissions in the heat and transport sectors, leading to lower overall emissions. In contrast, increased electricity demand from datacentres and continued growth in the industry, services and residential sectors does not displace fossil fuel use elsewhere in the economy. If total electricity demand increases ahead of the roll-out of renewable generation capacity it will lead to higher emissions. This will make it extremely challenging for the electricity sector to meet its national greenhouse gas emissions reduction obligations. The same principle applies with the requirement to reduce total final energy use in line with the EU Energy Efficiency Directive target35, and the requirement to increase renewable energy share in line with the EU Renewable Energy Directive (RED) target. For these reasons, the negative consequences compared to the benefits of allowing large new electricity users to establish in Ireland between now and 2030 need to be considered"*
- It is important to note data centre demand growth within SEAI projections, and the EirGrid data these are based on, are based on contracted data centre projects only, as their operation grows to meet their contracted connection level. Almost all of this extra load is contracted in the greater Dublin area and was contracted prior to a direction by the Commission for the Regulation of Utilities in 2021, which makes new connection agreements to be contingent on the ability of data centres to bring onsite dispatchable generation (and/or storage) with a capacity equivalent to or greater than their demand. This implies that these projections may under-estimate future demand growth, depending on new connections agreements and the rate that data centres ramp up operations to meet the contracted connection
- Moreover, these demand projections relate to electricity only: future natural gas demand is explored in the next section.

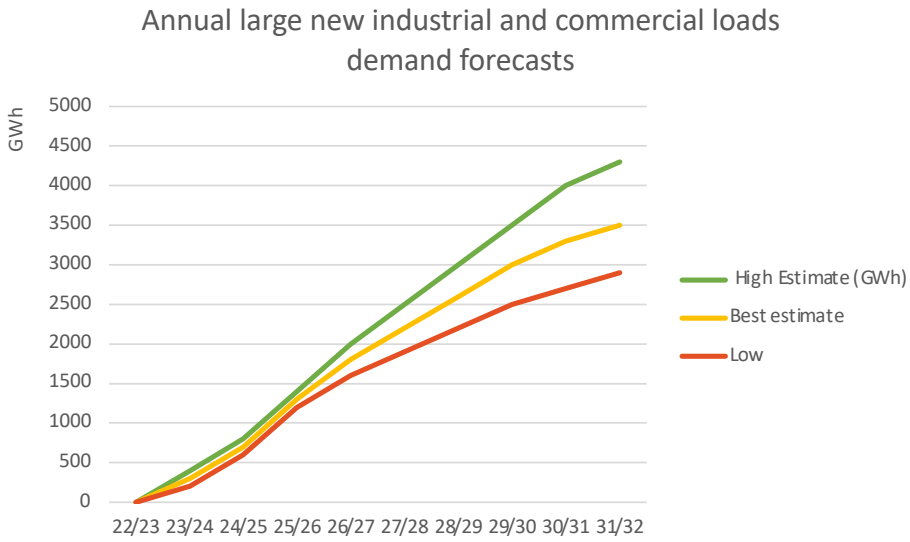
Figure 12: Final electricity consumption by scenario



[1]SEAI National Energy Projections, 2024
EirGrid and SONI, 'Generation Capacity Statement 2023-2032'. Jan 2024

Gas demand from data centres

- As per the 2021 CRU directive, offers of new data centre connections are contingent upon the ability of the data centre applicant to bring onsite dispatchable generation (and/or storage) with a capacity equivalent to or greater than their demand. This can be met with on-site renewables with battery storage, or gas or oil-based backup generators. Only the latter option is realistic for scaled power generation As a result, data centres in the Dublin area are connecting to the gas network, to enable on-site power generation. In 2024, 11 data centres have been approved to connect to the gas network, and an additional 22 have made connection requests, which Gas Networks Ireland are not progressing, pending publication of the CRU Connection Policy for Large Energy User[1]
- SEAI energy demand projections for data centres only cover electricity demand, and do not include direct demand for natural gas as a result of these gas connections. This is a blind spot in energy projections, and the EPA's projections of greenhouse gases, which rely on SEAI modelling. This also creates a blind spot in Ireland's Climate Action Plan, which is an annual report by Government to set out the policies and measures necessary to meet legislated carbon budgets and Sectoral Emissions Ceilings: additional natural gas demand will increase GHG emissions and increase the gap between projected emissions and legislated emissions ceilings. The scale of this gap is quantified in the next section.
- The figure to the right is developed using data from Gas Networks Ireland's Network Development Plan. It shows the demand for natural gas projected by GNI from data centre customers with connection agreements already in place (the "Low" scenario), and the Best and High estimates include new customers. According to GNI, the "Best" and "High" estimates for demand which implies a risk of increased growth, should additional connections be granted.

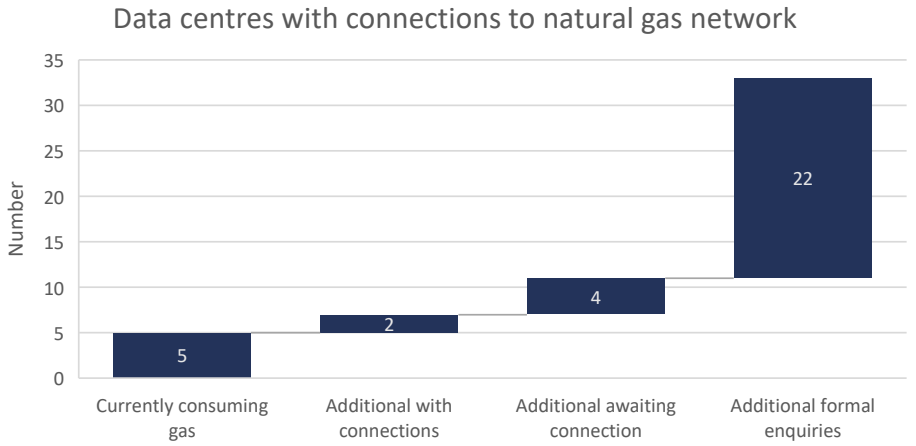


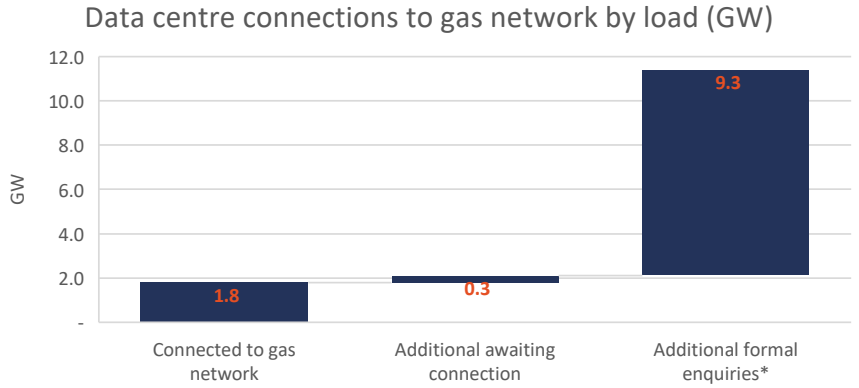
Source: Gas Networks Ireland Network Development Plan 2023: https://www.gasnetworks.ie/docs/corporate/gas-regulation/Network-Development-Plan-2023.pdf

[1] https://www.oireachtas.ie/en/debates/question/2024-11-06/33/#spk_284

Potential additional gas demand

- As of November 2024, GNI has advised DECC that 11 data centres have contracts to connect to the gas network[1] (representing 2.1 GW of aggregated maximum hourly load), of which 7 were in operation (1.8 GW), of which less than 5 are currently consuming gas. Of those with connection contracts to the gas network, 4 are awaiting connections, and an additional 22 additional data centres, representing 9.3 GW, made formal enquires, but have not yet secured contracts. The cumulative maximum capacity of data centres awaiting connections and who have made a formal enquiry represents a 540% increase on the capacity of those currently connected to the gas network. Gas Networks Ireland projects that natural gas demand from these enquiries ranges up to 1.3 GW, but is subject to considerable uncertainty.
- GNI is engaging with the Commission for Regulation of Utilities in relation to the impact of the July 2022 Government Statement on gas connection policy. GNI is not currently contracting more data centres pending the conclusion of this process.
- The above capacity figures relate to total maximum energy capacity, including gas and electricity. Actual gas consumption will depend on many factors, including the status of the electricity connection, timing of connection, the utilisation rate of data servers, the availability or constraints on the electricity grid (i.e., the rate that the TSO or DSO requires the development to switch to on-site power generation), and the potential for the data centre to switch fully to an electricity supply over time. GNI does not gather information on the anticipated duration of the gas connection from a potential data centre, and GNI does not classify data centres as "islanded" (those without an electricity connection) or not.
- No data is available to indicate actual gas use from the five data centres currently consuming gas. The SEAI's Energy Balances includes an estimate of energy use, including natural gas, for the "information and communication" sub-sector, however this is based on the 2022 Business Energy Usage Survey. In 2023, natural gas demand in this sub-sector was estimated to be 24 ktoe (280 GWh), around 0.6% of total primary energy requirement for natural gas in that year, according to the SEAI Energy Balance, but it is not clear if this includes natural gas from on-site power generation.





*Projected demand from these enquiries' ranges from 3.1MW up to 1,300MW; the aggregated demand represents the total developer's strategic long-term ambition which would be dependent on multiple factors including: ability to gain planning permission for multiple phases, availability of electricity grid capacity, permitting, data centre storage demand and route to market to fund these projects. Capacity figures relate to thermal input.

[1] https://www.oireachtas.ie/en/debates/question/2024-11-06/33/speech/284/

Potential impact of on-site gas demand

What is the maximum possible gas demand from data centres who have made formal enquiries to GNI?

- Data centres representing 2.1 GW of demand load currently have connection agreements to the natural gas network[1]. If these were running at full capacity and being powered entirely from natural gas (i.e., in fully "islanded" mode), the have the potential to consume 18,400 GWh of natural gas annually, which is around 38% of the total natural gas consumed in Ireland (across all sectors) annually. However, this is an implausible and extreme upper bound. But it does raise a critical question : what level of gas demand in the future is plausible?
- A number of factors influence the scale of this projected growth:
  - Firstly, more data centres are likely to connect to the network because they already received connection agreements. Currently, only 5 of the 11 data centres with connection agreement are consuming gas; 2 have connection agreements but are not consuming gas, and 4 are awaiting connections. In total, these represent 2.1 GW of maximum load.
  - Secondly, data centres typically take some time to power up to meet their maximum agreed load, though are not likely to use their full maximum agreed load.
  - Thirdly, some of these data centres will use gas for back up on-site power supply when supply on the power system is limited: this may be for a very limited period of the year. Moreover, some gas connections may be temporary However, GNI does not gather or publish data on the nature of the gas connections, and to our best knowledge, no stipulation in the connection agreement limits the the scale of gas usage.
  - And fourthly, an additional 22 data centres representing 9.3 GW of load have made formal enquiries to GNI, which has paused granting connections pending the finalisation of CRU's Large Energy User Connection Policy. There is uncertainty regarding the outcome of this connection policy, and also regarding the proportion of these enquiries that will materialise into formal developments.
- GNI projects that gas demand from the 11 data centres with existing grid connection agreements will grow from 200 GWh in 2023/24 to 2,700 GWh in 2030/31. GNI's "Best Estimate" scenario for gas consumption in 2030/31, which assumes some data centres will be granted new grid connection agreements, is 3,300 GWh, 600 GWh above the "Low" estimate, which only includes demand from the 11 data centres with existing connection agreements. However, the maximum load capacity of the 22 data centres who have made formal enquiries (9.3 GW) is around 5.5 times greater than that of data centres with existing agreements (2.1 GW).
- Therefore there is a risk that gas demand could be far greater than the level projected by GNI, depending on the four factors described above, even in the absence of new connection agreements. Should new connections be granted, the potential demand is very significantly greater. The theoretical annual maximum demand from all data centres who either have a gas network connection agreement, or who have made a formal enquiry, (representing 11.4 GW) is 100 TWh, which is around double Ireland's annual total primary natural gas demand. Again, this is not a plausible projection, but indicates the level of uncertainty and risk into the future.
- A more plausible estimate would take GNI's upper bound for projected demand from these enquiries – 1,300 MW (1.3 GW), and assume these are operational for 20% of the time (with the electricity grid used for the remaining 80% of the time). This would cause 2.3 TWh of additional natural gas demand annually.
- These calculations are not intended to act as projections or forecasts, but to demonstrate the significant risk that this trend for on-site natural gas connections creates for fossil fuel dependence, which is not being sufficiently explored. This risk is particularly strong for data centres which intend to fully bypass the electricity network and power all operations using on-site natural gas, but is also material for data centres which plan on a hybrid connections. On the other hand, if gas connections were temporary, data centres used them for a very small percentage of time, and switched to 100% renewables supply as quickly as possible, the risk would be minimal. However, it is not clear whether this outcome is realistic given the current extraordinary pace of demand growth.

[1] https://www.oireachtas.ie/en/debates/question/2024-11-06/33/speech/284/

Impact on greenhouse gas emissions & carbon budgets

What are the greenhouse gas implications of data centres, and how will they impact on the achievement of carbon budgets?

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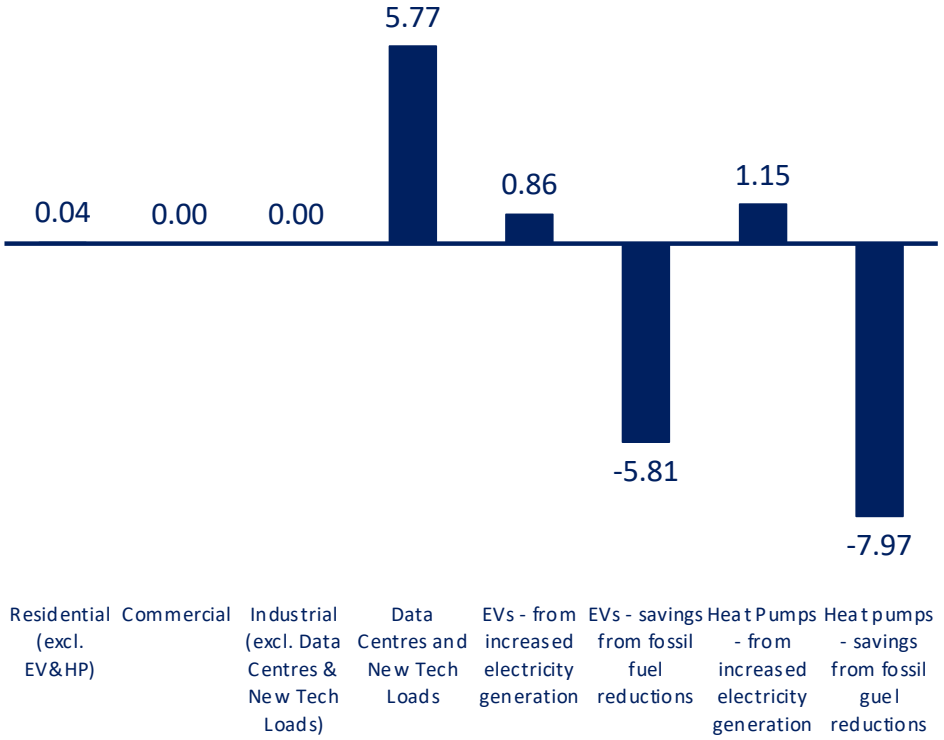
Greenhouse gas emissions from data centre electricity demand

- We estimate potential additional GHG emissions from both the additional electricity demand, and additional natural gas demand. Bitpower[1] used this approach to estimate that data centres' electricity demand emitted 1.53 million tonnes of CO2 in 2023, 2.5% of Ireland's total GHG emissions, or 4.5% of total CO_2 emissions. This applied the gird average CO_2 intensity of power generated in 2023, 255 gCO_2/kWh
- This approach is also used in the graph to the right, which calculates the GHG emissions from new electricity loads, and also GHG savings from shifting demand from fossil fuels to electricity in transport and heating. This estimate uses the average carbon intensity of the electricity grid now and in the future, according to the EPA's With Additional Measures scenario. This uses EirGrid's Median demand scenario for data centre growth, and assumes the average GHG intensity of CO_2 generation falls in line with government policy. It finds that the GHG savings from EVs and Heat Pumps significant outweigh the additional emissions from their operations, and that new data centre loads cause nearly 6 million tonnes of emissions in the period 2021-2030.
- This approach allocates the "credit" for new renewables equally to all sources of demand. This approach has advantages and disadvantages. On the one hand, it treats all existing and new loads equally, based on total annual electricity demand. On the other hand, if a substantial new source of demand, like data centres, is causing greater fossil fuel usage directly, or indirectly by diverting renewables capacity away from powering existing energy demand, then it could be argued that this approach is favorable to new loads.
- An alternative approach to estimating the GHG impact of new data centre loads is to apply the GHG intensity of electricity using the share of renewables capacity directly procured by data centre developments, and assume that the remaining share is delivered with natural gas. Using this approach, if we assume that 16% of new data centre loads are realised with renewables through CPPA, and the remainder through grid-scale gas generation, then the cumulative emissions from power demand from data centres over 2021-30 rises to 14.6 million tonnes.

[1] https://bitpower.ie/images/Reports/2024_Q4_Market_Update_Ireland_v1-2.pdf

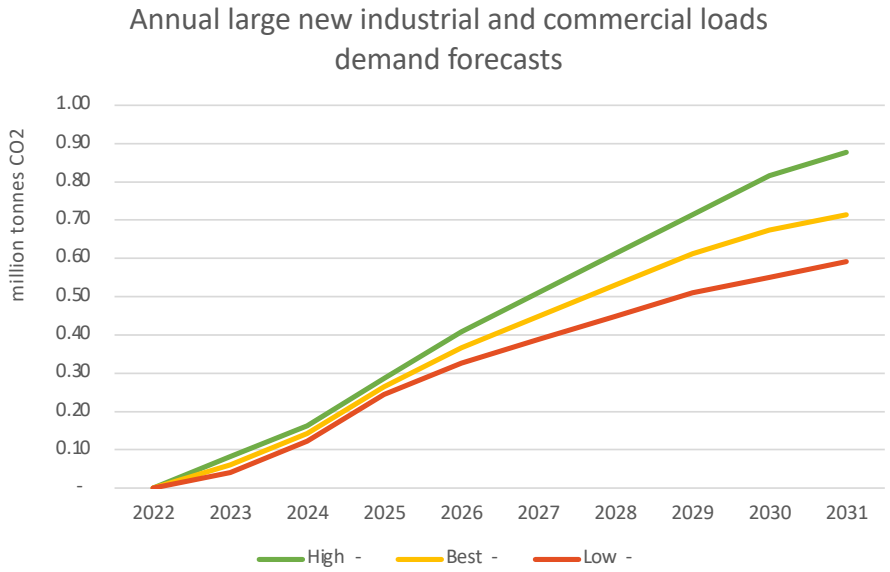
Cumulative Greenhouse Gas emissions of new electricity loads to 2030 (million tonnes CO_2)



Source: Own calculations based on Dr. Paul Deane https://www.esri.ie/sites/default/files/media/file-uploads/2024-06/7.%20Paul%20Deane_ESRI%20Presentation_PDeane%20June2024.pdf

GHG emissions arising from on-site gas generation

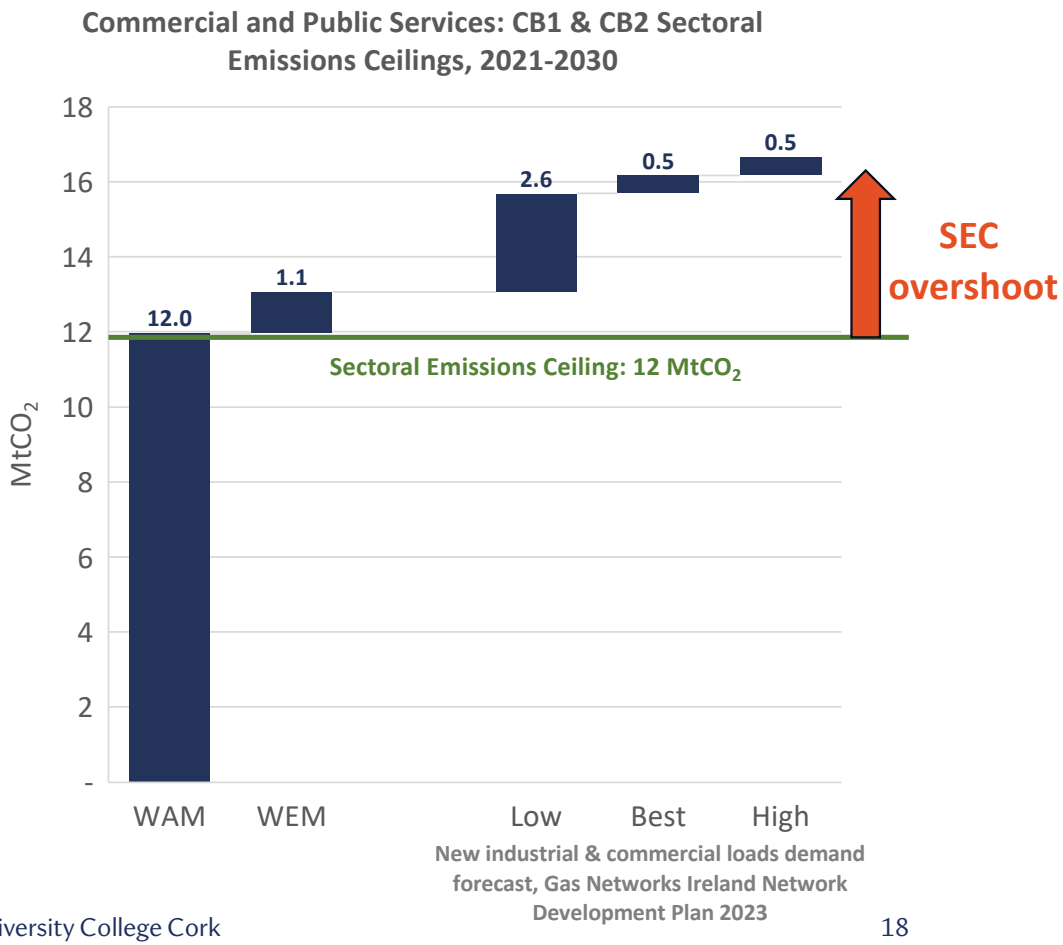
- Additional GHG emissions from natural gas demand arising from new industrial and commercial loads, according to GNI's Network Development Plan, is up to 900,000 tCO_2 in 2031. (See Gas Demand from Data Centres).
- To our best knowledge, these emissions arising from additional demand for natural gas from new industrial and commercial loads arising from data centres are not factored into SEAI's energy projections, and therefore not included in EPA GHG projections under "With Existing Measures" and "With Additional Measures" scenarios. Therefore, Ireland's Climate Action Plan is not taking account of an even greater gap between sectoral emissions ceilings and GHG emissions based on current projections.
- The cumulative impact of this additional natural gas demand on carbon budgets is explored in the next page.



Source: Own calculations based on Gas Networks Ireland Network Development Plan 2023: https://www.gasnetworks.ie/docs/corporate/gas-regulation/Network-Development-Plan-2023.pdf

Impact of new natural gas demand on SECs

- GHG emissions arising from this additional natural gas demand is calculated in the figure presented here. It is counted within the Commercial and Public Services sector within the greenhouse gas inventory, and therefore in the Services sector Sectoral Emissions Ceiling (SEC). EPA's GHG projections show that under the "With Additional Measures" (WAM) scenario, emissions for this sector are projected to be in line with its SEC. Apart from the "other" category, this is the only sector that is currently the case. Under the "With Existing Measures" Scenario (WEM), cumulative emissions are projected to be an additional 1.1 $MtCO_2$ over 2021-30.
- However, this new analysis shows that counting the additional emissions arising from natural gas from new industrial and commercial loads - data centres with connections to the gas network – the sector will exceed its SEC by a minimum of 2.6 $MtCO_2$ (Gas Networks Ireland's "Low" scenario), and up to 3.6 $MtCO_2$ (the "High" scenario). According to GNI, the Low scenario has been limited to Data Centre customers with connection agreements already in place.
- This calculation reflects GNI's projections. However, as shown in the previous section, the maximum potential gas demand from data centres seeking gas connection agreements is significantly higher than projected by GNI. The maximum annual gas demand from data centres who have secured a connection agreement is 18.4 TWh, which would emit 3.8 $MtCO_2$, and the maximum demand from those seeking a connection agreement is 81.5 TWh, which would cause emissions of 16.6 $MtCO_2$. In total, the maximum potential annual GHG emissions from data centres' gas connections is 20 $MtCO_2$ – which is equivalent to 68% of all CO_2 emissions arising from fossil fuel combustion in Ireland in 2023.
- We stress again that this is not a plausible scenario, but a theoretical maximum: It would require that all 33 data centres with connection agreements, or who have made formal enquiries, are granted agreements, are built, are operated continuously at their full maximum load and are fully powered using on-site natural gas generators. Consultation with the industry and GNI would be required to establish a plausible level of demand, in order to make a more credible projection of GHG emissions. However, it indicates an enormous risk to Ireland's carbon budgets, and energy security, beyond the threat that is already apparent from gas projections in GNI's Network Development Plan. This risk is clear when considering that a single planned data centre in Kildare, owned by Herbata, would cause 28.6 million tonnes of CO_2 over its lifetime, which is 4% of Ireland's total carbon budget [1].



[1] https://www.irishtimes.com/business/2024/10/08/kildare-county-council-says-planned-data-centre-runs-counter-to-national-policy/

Biomethane

What are the greenhouse gas implications of data centres, and how will they impact on the achievement of carbon budgets?

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Can biomethane mitigate GHG emissions from data centres?

- Biomethane has been proposed as a mitigation strategy to address the gas demand from data centres. For example, according to Gas Networks Ireland's Network Development Plan: "*There is a clear preference for Data Centre developments that can demonstrate the additionality of their renewable energy use in Ireland and can demonstrate a clear pathway to decarbonise and ultimately provide net zero data services.... Gas Networks Ireland believes that Data Centres connecting to the gas network could meet these principles through the increased use of biomethane and hydrogen while also assisting in establishing indigenous renewable gas markets in Ireland.*"
- However, this reasoning is misleading, using logic is the same that is used to justify expanded data centre power demand to create a market for renewables developments. It confuses targets for clean energy deployment – which in this case is biomethane – with their ultimate objective, which is to replace existing fossil fuels in order to meet legally-binding carbon budgets. Diverting any biomethane that is produced to serve additional demand will divert it from displacing fossil fuels in the electricity mix or for heating.
- The Irish Climate Action Plan (CAP) includes a target to develop 5.7 TWh of biomethane by 2030, which is required to contribute to decarbonising heating and industry by displacing fossil fuels.
- Moreover, the scale of natural gas demand from data centres cannot feasibly be reached by biomethane. The gas demand from GNI projections is equivalent to more than 60% of the biomethane target in the CAP, and this does not include significant demand from data centres who have made formal enquiries, including those which propose to run in "islanded" mode, without relying on the electricity network. One such proposed development, developed by Herbata, would consume the equivalent of half the total national biomethane target in 2030[1].
- According to the Sustainable Energy Authority of Ireland, "*It is possible that significant quantities of biomethane could be purchased by datacentres for use in off-grid electricity generation. Because grid electricity will be 80% renewable by 2030 and because of the losses incurred in electricity generation, any use of biomethane for off-grid electricity generation would be a highly sub-optimal use of this limited and valuable resource.*"[2]
- Short-term increases in fossil fuel use, relying on future biomethane injections, will undermine Ireland's ability to meet carbon budgets—the legal foundation of climate commitments
- Moreover, there are no detailed plans or guarantee that biomethane will be supplied in a timely manner.
- Finally, there are significant trade-offs and costs associated with biomethane production. Biomethane production at scale in Ireland would require significant volumes of sileage, because waste is a finite resource. Increased sileage volumes require greater land area, and threatens indirect GHG emissions through land use intensification and indirect land use change. SEAI classifies biogas produced with sileage using current cultivation practices as "high risk"[2]

[1] https://webgeo.kildarecoco.ie/planningenquiry# File 2460787
[2] https://www.seai.ie/renewable-energy/bioenergy/biomass-in-ireland
https://www.seai.ie/renewable-energy/bioenergy/sustainability-criteria-o
https://www.seai.ie/sites/default/files/publications/Assessment-of-Cost-and-Benefits-of-Biogas-and-Biomethane-in-Ireland.pdf

Power purchase agreements

To what extent are corporate power purchase agreements (CPPAs) meeting the growth in data center power demand?

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Are PPAs meeting data centre demands?

- A corporate power purchase agreement (CPPA) is a long-term contract between an energy producer (typically a renewable energy provider) and a buyer (such as a data centre) to purchase electricity at a pre-agreed price. PPAs help energy producers secure funding for projects by guaranteeing revenue, which offers finance for renewable energy projects and an alternative route to market from renewable energy auctions, while buyers benefit from stable energy pricing and potentially lower carbon footprints.
- Globally, CPPAs for renewable energy were pioneered by big tech companies, but evaluating the impact of this renewable procurement is not straightforward. Typically, the contracts are purely financial: the data centre is physically supplied with electricity by the central power grid, while the renewable electricity generated from the project is sold from where it is placed. This is a beneficial arrangement for a renewable developer, who can finance a project through a CPPA, and a data centre developer, who can secure a guaranteed electricity price and meet corporate emissions goals, but it does give rise to three important questions.
    1. Firstly, what is the additionality of this renewable capacity: would it have been built in the absence of the financial agreement, or is this investment "crowding out" other renewables projects by causing congestion, for example in planning or supply chains?
    2. Secondly, what is the coverage: how much of the electricity demand growth from data centres was matched by power generation from CPPAs?
    3. And thirdly, what is the time-matching of energy consumption from data centres with the generation from procured renewables generation?

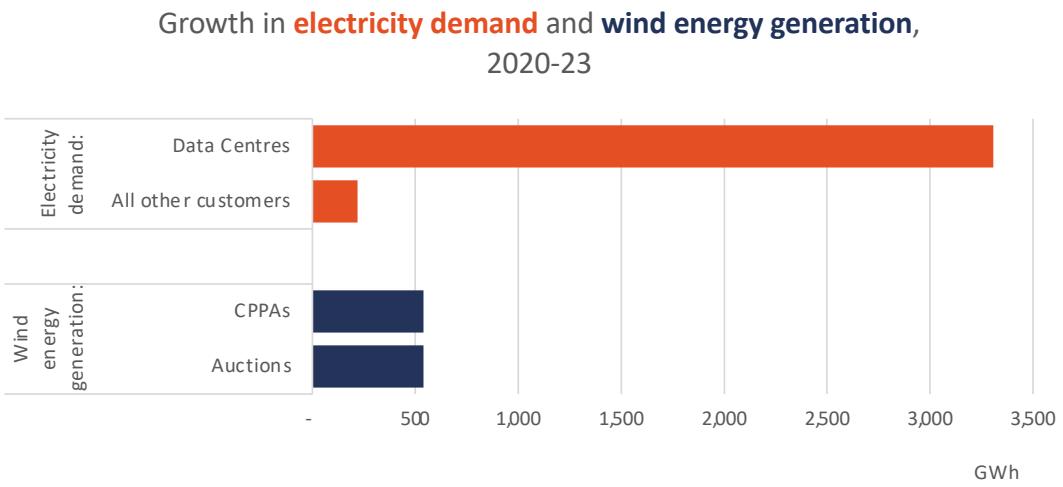
Irish policy on CPPAs and data centres

- The Government's Climate Action Plan 2019 included a target that 15% of electricity demand in 2030 is met by renewable sources contracted under CPPAs. However, subsequent Climate Action Plans which have been published under the Climate Act framework have not included a specific reference to CPPAs
- The Renewable Electricity Corporate Power Purchase Agreement Roadmap was published by the Government in March 2022. The roadmap sets out that CPPAs have an important role to play in helping Ireland to reach renewable electricity targets and includes the Principles of Good Practice for Renewable Electricity CPPAs, which state that "such agreements should clearly deliver additional GHG emissions reductions and contribute to Ireland's 2030 renewable electricity and climate targets,
    - Lower the net costs of the energy transition to Irish consumers and the State;
    - Be measured and reported in a way that accurately reflects actual emissions
- A strategy of procuring renewables through CPPAs have formed a significant part of the strategy of some tech companies with a significant presence of data centres in Ireland. For example, Meta has signed PPAs to buy the output of two of Ireland's largest solar farms in 2023[1]

[1] https://www.businesspost.ie/news/meta-buys-total-output-of-two-of-Irelands-largest-solar-farms/#:~:text=Both%20solar%20farms%2C%20which%20have,centre%20in%20Clonee%2C%20Co%20Meath.

Are corporate power purchase agreements (CPPAs) meeting the growth in data center power demand?

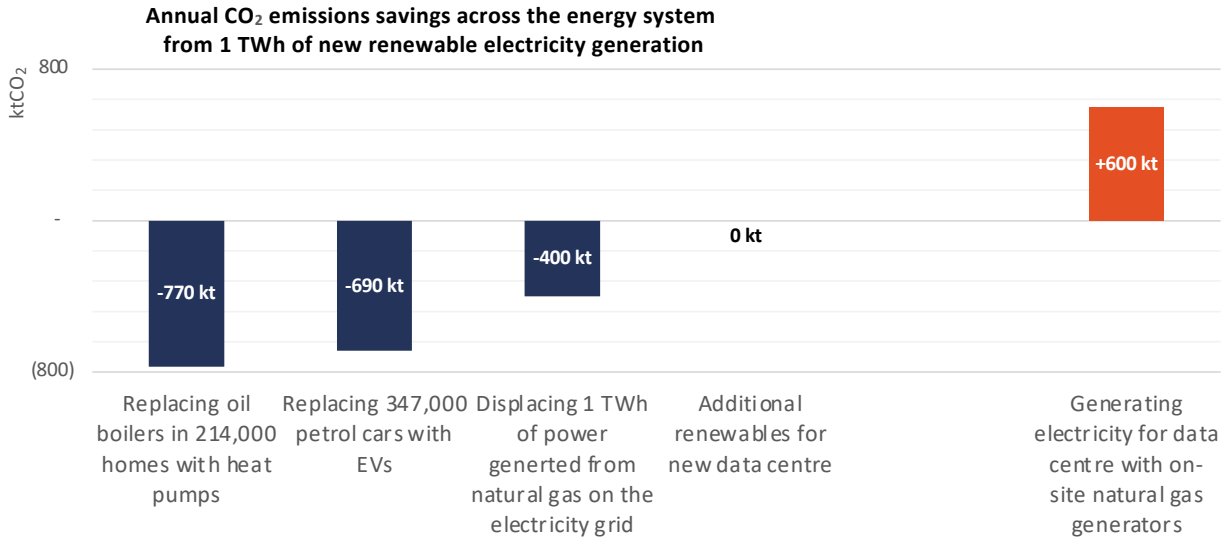
- According to industry estimates, half of the new wind energy capacity developed between 2020 and 2023 was financed though CPPAs.
- The chart to the right estimates that this led to just over 500 GWh of renewable energy generation over this period. However, this only met 16% of the new electricity demand from data centres between 2020 and 2023, which was over 3,000 GWh. In other words, data centre demand grew 6 times faster than new projects financed by CPPAs, and more than 15 times faster than electricity from all other sources – homes, vehicles, industry.
- From this analysis, it is clear that electricity demand from data centres is far outstripping the additional renewable energy being procured through CPPAs over the past three years, and the proportion of CPPAs undertaken by data centres is itself unknown.
- The narrative that procuring additional renewables capacity through CPPAs helps meet the targets under Ireland's climate act is not valid, because total energy demand is rising much faster than additional renewables, and that energy has to be met through additional fossil fuels. As before, it is cumulative greenhouse gas emissions, not gigawatts of renewables capacity, that is the legal basis for Ireland's decarbonisation commitments (and what matters for the climate).



Sources:
- Electricity demand growth: CSO
- Wind energy generation: Estimated from capacity growth (SEAI) and industry estimates for CPPA share

GHG emissions from diverting renewables generation

- This analysis shows that in the Irish context, the **coverage** of additional power demand from data centres is very limited. Only an estimated 16% of the growth in DC demand between 2020 and 2023 was met with CPPAs.
- The graph to the right shows the impact of diverting 1 TWh of renewable electricity to new loads, like a data centre, from displacing either electricity generated from a gas-fired power plant on the electricity grid, or to produce electricity to replace oil in home heating or transport.
- The graph below illustrates why it is so important, from a climate perspective, to focus new renewables on replacing fossil fuels than on serving additional demand from new data centres. It also illustrates why serving new data centre demand through on-site natural gas generators, which are less efficient than grid-scale generators, offsets large emissions savings efforts from other sectors.



Assumptions:
- Heat pump with COP of 3 replacing oil boiler emitting 257 gCO_2/kWh - would be higher with retrofit measures
- EVs with efficiency 0.16 kWh/km replacing ICE emitting 110 gCO_2/km
- Assumed GHG intensity of 400 gCO_2/kWh of large-scale CCGT natural gas, and 600 gCO_2/kWh for on-site generation

Commission for the Regulation of Utilities (CRU) demand policy

How can new policy developments described in the Commission for Regulation of Utilities review of Large Energy User connection policy contribute to the decarbonisation of data centres?

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CRU National Energy Demand Strategy

A National Energy Demand Strategy (NEDS) Decision Paper, published by CRU in July 2024, comprises three areas: 1. Smart Services, 2. Demand Flexibility and Response, and 3. New Demand Connections. The third area describes the process for developing a Large Energy User (LEU) Connection Policy. A central focus of the policy is to develop initiatives that can contribute towards demand flexibility in the short term, in addition to defining the longer-term strategic plan. CAP23 set a target for electricity system demand flexibility of 15-20% by 2025 and 20-30% by 2030. Shifting electricity demand to times of high renewables generation through flexibility mechanisms can enable greater emissions reductions and lower costs.

A second focus of the NEDS is to set out the parameters of a strategy to balance growing energy demand with Ireland's carbon budgets. One of the objectives, pertinent to this report, is to "*set out measures to ensure that overall electricity and gas demand is consistent with Ireland's carbon SECs*". According to the paper, in the long term additional demand will be decoupled from emissions growth, but *"at present, and in the short to medium term, electricity generation still produces significant emissions due to the role of fossil fuels in the generation mix. There are limitations, therefore, on the amount of electricity that can be consumed while simultaneously meeting the legal requirements set out in the Climate Act 2021".*

The focus on the third area in this paper, New Demand Connections, is initially focused on building flexibility contributions from LEUs seeking to connect. This will include reform of the pathway for new LEU connections to the electricity and gas systems so as to support security of supply, flexibility and minimise the impact on national carbon emissions.

The paper builds from the *Review of Large Energy Users Connection Policy* consultation paper, published in January 2024, which aims to set out a pathway for LEUs to connect to gas and electricity networks while addressing concerns around security of supply, network constraints and emissions.

The NEDS notes that *"the connection criteria that will be introduced as part of the new LEU connection policy currently in development and the extent of new LEU demand customers that connect under this policy. There is an expectation that LEUs will provide significant demand flexibility, noting the statement in CAP23 that 'Large Energy Users (LEUs) will be expected to make a higher proportional contribution to the target'".*

Chapter 6 of the Annex of the NEDS Decision Paper sets out the role of new demand connections, particularly LEUs, in building out demand flexibility in Ireland. It discusses the importance of incentivising new LEUs to provide flexibility as well as the interaction between the decarbonisation of energy demand, the gas network, and options for incentivising flexibility for non-LEU connections. This Annex also sets out the national and European legislative and policy contexts, and describes current emissions trends with regard to legislated SECs. Noting that emissions from the electricity sector are projected to overshoot the SEC, "it is important to recognise that these [scenarios] are based on assumptions that may not reflect the appetite for additional demand to accommodate economic growth, particularly with respect to the technology sector and data centres."

It should be noted that for new demand connections, the provision of flexibility and the impact on carbon budgets are two distinct topics. For example, demand from an LEU such as a data centre could be considered flexible if its operation is aligned with renewables generation on the grid, and powers down at times of low renewable generation, or if it switches to on-site fossil fuel-powered generation. However, in both of these cases, the source of new energy demand may be misaligned with carbon budgets. This is clearly the case for on-site power generation with fossil fuels, but is also the case if the renewable electricity consumed by the data centre could otherwise be used by existing energy customers, or be stored for times of low renewable generation.

NEDS Recommendations and Actions

Recommendations

The key recommendations for Government Departments, particularly DECC and DETE, to support the implementation of the NEDS are summarised below.

1. Policy measures regarding carbon emissions & SECs
    - Monitor the relative share of carbon emissions across the range of energy systems users. Consider whether further policy measures are required, including whether the legislative remit of the system operators remains appropriate with regards to adopting measures that prioritise decarbonisation. [Annex chapter reference: 3.3]
2. Enhanced emissions reporting framework - Part 2 (*Area 2D: Demand Flexibility & Response – Information, Certification and Reporting*)
    - Provide clarity and define the implementation and supporting actions required to complete delivery of the emissions reporting framework (CAP23 action: EL/23/27). [Annex chapter reference: 5.1.1]
3. Consider a national strategic approach for the facilitation of new LEU connections (*Area 3: New Demand Connections*)
    - Consideration to be given to a national strategic approach for the planning of large demand customers and associated infrastructure requirements (e.g. energy water, broadband, transport etc.), the associated costs and benefits, and any potential risks arising from high volumes of similar demand customer types. [Annex chapter reference: 6]

Actions

The NEDS describes 50 actions covering the three areas over 2024-2026, including responsible bodies, target completion dates and interdependencies. Actions relevant to the role of data centres in meeting Ireland's carbon budgets include the following:

- 0.1: Governance arrangements for NEDS implementation
- 0.2: Review the impact of NEDS on carbon emissions
- 2.19 & 2.20: Electricity & gas system emissions information
- 2.21: Enhanced emissions reporting framework: Deliver the design report for an enhanced emissions reporting framework for electricity emissions for LEUs
- 2.23: Certification of additionality for (a) power and (b) renewable gas:
- 2.24: Development of scenarios to define the future role of the gas network.
- 2.26: Support planning for the future role of the gas network and pathway for implementation:
- 3.1: Publication of new LEU connection policy

CRU Large Energy Users Connection Policy

The Climate Action Plan 2023 tasked the Commission for Regulation of Utilities, (CRU), with the delivery of a National Energy Demand Strategy, with the aim of 20% to 30% of electricity to be flexible by 2030. Large Energy Users will be expected to make up a higher proportional contribution to the flexibility target, as they are making up a high proportion of the increase in electricity demand. As part of this strategy, the CRU is also undertaking a review of the connection policy for Large Energy Users to the gas and electricity systems. The aim of this review is to provide a new pathway for Large Energy Users to connect to the electricity and gas systems, that minimises the impact on national carbon emissions while also taking account of the capacity of energy and grid infrastructure.

A Consultation Paper on the Review of Large Energy Users Connection Policy, published by CRU in January 2024, includes questions the following elements:

- **Reporting real-time emissions data:** Transparency around real-time GHG emissions is essential to inform the public debate and policy decisions on the relative costs and benefits of data centres
- **Data centres to be subject to flexible power connection contracts** in constrained locations of the grid – i.e., data centres may not secure a firm connection agreement to the power grid connection, could be asked to reduce power demand at constrained times. This policy could lead to a decrease in GHG emissions if reduced power demand was realised through lowering operation at the data centre. However, it would lead to increased GHG emissions if it caused a switch to on-site power generation, likely fuelled by gas and diesel, unless this was explicitly ruled out
- **Prove the "additionality" of any renewable power purchase agreements,** through regulator-certified system, to ensure they are not claiming renewable projects that are already in development. It is not clear how this policy will seek to establish the additionality of data centres' renewables procurement, for example including the possibility that the procured renewables project would not have been financed through other means, or that the project didn't diverted resources or create bottlenecks in the planning and development stages.
- **Islanded data centres,** which are not connected to the electricity grid at all and run off their own power generation, are expected to only be allowed a gas grid connection if they can demonstrate an ability to align with carbon budgets in the power sector. This report has demonstrated that new gas connections will increase greenhouse gas emissions and threaten the sectoral emissions ceilings of both the power and services sectors. It is not clear how the CRU policy intends to count these emissions, and how it would require data centres to align with carbon budgets. It is critical to ensure that any biomethane or hydrogen would also be additional, and would not be diverted from replacing existing fossil fuels usage.
- Additional analysis and feedback to the CRU Energy Demand Strategy Call for Evidence from MaREI and UCC can be viewed here.

An Electrification Action Plan

How can electricity demand grow along with renewables to replace fossil fuels, rather than serve new demands?

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An electrification strategy

Renewables are serving demand growth, not replacing fossil fuels

- Expanding renewable energy capacity is rightly a central mission in Ireland's climate strategy. However, renewable energy supply is only one half of the picture. Its possibility to decarbonise Ireland's energy system, and reduce fossil fuel dependence, if the power produced from wind and solar farms is used to replace fossil fuels through electrification.
- However, as the data in this report has shown, all the increase in renewables generation between 2017 and 2023 has been matched by demand growth from data centres: at the country level, this means renewables have been "running just to stand still" - fossil fuel use has not declined, and emissions remain stubbornly high. This disconnect threatens Ireland's ability to meet carbon targets.
- The data centre industry argues[1] that its growth is necessary to decarbonise Ireland's economy, claiming that new customers electricity customers are needed to support offshore wind development. While it's true that Ireland may one day produce a surplus of clean electricity to meet the needs of power-hungry industries like data centres, this argument ignores the present reality. Today, the extraordinary growth in energy demand from data centres is straining our electricity system and delaying emissions reductions.
- Renewable developers are seeking PPAs with data centres to secure a guaranteed customer to buy their power at a fixed price: future electricity demand is uncertain, and renewables developers cannot all get contracts through renewable auctions.
- This points to an important gap in Ireland's energy policy – clean electricity can power homes, vehicles, and industries, directly replacing fossil fuels. Yet, electrification is happening far too slowly. Moreover, if renewables are diverted to serving data centre demand growth, this may limit the ability of existing energy-intensive industrial consumers to electrify, risking them being left with a more carbon-intensive fuel mis.

An Electrification Action Plan

- An Electrification Action Plan could create a bridge between Ireland's renewable energy potential and climate commitments. This would entail developing a strategy to accelerate the electrification of existing industry, transport and buildings
  - Ireland's **transport** is almost entirely reliant on combustion engines, but electrification is possible and would bring massive benefits. Progress on this front has regressed – EV sales dropped last year with concerns about depreciation, but new electric vehicles are hitting price parity with fossil fuelled cars, and the electrification of busses and tricks is becoming more viable with advancements in battery technology and falling costs.
  - **Industry** is also poised for electrification. Today, 28 per cent of industrial energy demand is met with electricity, but this share has barely increased in two decades. The remaining demand is mainly for heat, which is met by fossil fuels. According to the Sustainable Energy Authority of Ireland, more than half of this can be electrified, and new innovations like thermal batteries can work well with a variable renewable electricity system. Shifting energy-intensive industries from natural gas to electricity would cut emissions, improve energy security, and make industry less vulnerable to fluctuating fossil fuel prices.
  - The electrification of **heating homes and businesses**, with both heat pumps and heat networks also needs to be prioritised.
  - Ireland's offshore wind capacity will eventually exceed domestic electricity needs. Instead of defaulting to data centres, this surplus could power innovative industries that address global challenges. For example, Ireland could produce synthetic fuels for aviation, or even novel proteins and green fertilisers to decarbonise agriculture. Clean electricity could also support carbon removal technologies like Direct Air Capture to help reverse climate change, which is increasingly likely to be necessary given how close the world is to crossing dangerous climate tipping points

[1] Cloud Infrastructure Ireland "Key to unlocking Irelands Offshore Wind Potential", November 2024

Conclusions

Key findings

- **Energy demand from data centres**
  - Data centres are the primary driver of Irish electricity demand growth, matching growth in renewable energy generation.
  - Current growth trends risk locking Ireland into higher emissions, delaying decarbonisation.
- **Greenhouse Gas Emissions**
  - Significant GHG emissions arise from both increased electricity and gas demand, creating further overshoot of legislated carbon budgets.
  - Data gaps in emissions tracking undermine efforts to fully assess carbon budget impacts.
- **Policy gaps**
  - CPPAs provide limited mitigation, with only 16% of data centre demand covered by additional renewable capacity between 2020 and 2023.
  - Biomethane as a mitigation strategy is unsustainable under current targets and production capacities.
- **Additional Risks**
  - On-site gas generation by data centres creates inefficiencies and shifts energy security risks to the gas network, and creates the risk of long-term gas lock in

Recommendations

- **Energy demand management**
  - Enforce stricter conditions on data centre connections to ensure alignment with carbon budgets.
  - Mandate flexible power contracts to limit peak demand impact.
- **Renewables and electrification**
  - Prioritise renewable deployment for sectors that directly replace fossil fuel use.
  - Develop an “Electrification Action Plan” to accelerate decarbonisation in transport, industry, and heating.
- **Policy development**
  - Introduce mandatory real-time GHG emissions reporting for data centres.
  - Enhance regulation around CPPAs to ensure additionality and time-matching of renewable generation.
- **Data transparency and research**
  - Improve data collection on gas use, on-site emissions, and renewable energy procurement.
  - Undertake detailed research on the extent to which data centres are increasing GHG emissions, including from electricity imports.