THE IRISH ACADEMY OF ENGINEERING

ENGINEERING & TECHNOLOGY

THOUGHT LEADERSHIP IN A TIME OF GREAT CHANGE

Sustainable Electricity in 2030

Reliable?
Affordable?

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THE IRISH ACADEMY OF ENGINEERING

The Irish Academy of Engineering is an all-island body, concerned with long-term issues where the engineering profession can make a unique contribution to economic, social and technological development.

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Drawing on the experience and knowledge of its experienced members, the Academy works to facilitate communication and dialogue on engineering-related matters. It regularly publishes reports and analyses, some jointly with other learned & professional bodies.

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CONTENTS

EXECUTIVE SUMMARY

Faced with the most challenging energy transition in history, the Academy is concerned at the slow pace at which policy change is being implemented, at the lack of a coherent financial and economic analysis and at the failure to efficiently manage reliability risk.

Preliminary estimates of the cost to 2030 of the Irish energy transition range from €60Bn (MaREI) to €200Bn (IMF). In this context this report poses the following important questions:

1. When will policymakers publish a comprehensive and coherent **financial and economic analysis** of the proposed changes up to 2030 which will quantify the likely electricity price increases1 and tax arrangements necessary to fund the required investment and retain current reliability standards?
2. At a time of great change, why does it take two and a half years to complete a **Review of Ireland's Energy Security?** (Commenced in Nov 2019, *now scheduled* for completion in Spring 2022)
3. What arrangements are proposed to ensure the long-term **availability of natural gas** for Ireland given that Irish natural gas reserves will be entirely depleted by 2030 and the UK will, by then, import 75% of its natural gas while Ireland will have to continue to rely on gas fired generation as a backup for intermittent renewable power for the foreseeable future?
4. Why did the current process for ensuring the timely **addition of generation capacity** to the Irish power system recently fail resulting in the proposed leasing for six months of 200MW of "**Emergency Generation**"? (The first time Ireland has had to resort to this option). The Academy notes with concern the subsequent sudden cancellation of this generation within a matter of weeks of the original announcement.
5. What measures do policy makers propose in order to advance **long delayed critical transmission** projects such as the North-South interconnector and the Laois 400kV substation?
6. Why are regulatory bodies only now confronting the clearly foreseeable supply issues posed by the **concentration of data centres** in the Dublin area?

1 https://data.oireachtas.ie/ie/oireachtas/committee/dail/33/joint_committee_on_environment_and_climate_action/submissions/2021/2021-07-06_opening-statement-aoife-macevilly-chairperson-commission-for-regulation-of-utilities_en.pdf

1. INTRODUCTION

In 2019 the Government set out a Climate Action Plan (CAP) establishing ambitious targets aimed at decarbonising Ireland's energy supply by 2050. The more recent Programme for Government (2020) established even more ambitious interim targets, proposing a 7% Year-on-Year (7% Y-o-Y) reduction in Greenhouse Gas (GHG) emissions by 2030. The revised plan doubles[2] the rate at which GHG emissions must be reduced over the coming decade.

Over the past two years the Irish Academy of Engineering (IAE) has considered these targets and sought to establish as early as possible the overall shape of a feasible greenhouse gas (GHG) reduction plan for the Irish electricity industry and the potential challenges which must be overcome in order to meet these targets.

The Academy does not question these targets which it understands have been established based on international agreements.

The Academy is acutely aware of the requirement for social and community support which is critical to the success of such a major transition. Such support requires strong political leadership, healthy debate and an emphasis on sharing all relevant information. It requires professional analyses of the techno-economic impact of the transition and communication of these analyses to the public.

While acknowledging the contribution of studies from organisation such as MaREI, the Academy continues to be concerned at the lack of more detailed analysis and informed debate.

Ambitious targets, without detailed plans, will not, of their own, achieve the required results.

Recently, there has been considerable media interest in important energy issues –particularly the powering of data centres. The Academy welcomes this debate.

The Commission for the Regulation of Utilities (CRU) has recently confirmed[3] that:

- The risks posed to the reliability of the power system are increasing.
- Gas fired generation is critical for the future reliability of the power system.
- The energy transition will lead to an increase in electricity prices.
- It now has concerns over the increasing electricity demand from data centres.

The struggle to meet the present increase in demand casts serious doubt on Ireland's ability to power the 900,000 Electric Vehicles (EVs) and 450,000 heat pumps envisaged in the Government's projections for 2030 while retiring over 1550 MW of coal, oil and peat/biomass fired generation over the same period.

The Academy notes the recent cancellation of the *"Emergency Generation"* contract following an objection from a third party on commercial grounds. These sudden policy changes do not engender confidence in a process intended to ensure that Ireland's power system can meet demand over the medium to long term.

EirGrid has sought guidance on the future shape of the Irish power industry, particularly in respect of the social acceptability of constructing new transmission infrastructure. The Academy has contributed[4] to EirGrid's consultation.

This paper summarises the current position in relation to issues raised by the Academy in the recent past:

- The Challenges of High Levels of Renewables (March 2021),
- The Future of Transmission (October 2020).
- Electricity Sector Investment for Data Centres in Ireland (August 2019).

It also identifies some new issues which are now appearing on the horizon.

2 http://www3.weforum.org/docs/WEF_Accenture_ESB_Ireland_System_Value.pdf
3 https://www.oireachtas.ie/en/oireachtas-tv/video-archive/committees/?page=3&datePeriod=all&resultsPerPage=20
4 http://iae.ie/wp-content/uploads/2021/07/IAE-Response-to-EirGrid-18-May.pdf

2. ISSUES FOR CONSIDERATION

The important issues summarised in this paper include:

- The lack of a comprehensive financial and economic analysis of phase 1 of the energy transition up to 2030. This is now long overdue.
- The increasing risk to power system reliability.
- The strategic risk of interruptions to gas supply.
- The lack of progress on Transmission Investment.
- The barriers to data centre expansion in Dublin

2.1 The continuing absence of a comprehensive financial and economic analysis

Over the years a small number of estimates have emerged of the capital investment required to fund the energy transition to 2030.

In 2016 the Academy produced an initial estimate[5] of the investment cost to achieve the much easier targets set at the time. This initial estimate of €35 Billion for all sectors was recognised as having a wide range of uncertainty and the Academy encouraged the production by other organisations of more reliable estimates.

In 2020 MaREI[6] produced an initial estimates of the cost of decarbonising the electricity sector by 2030. The report estimated that approximately €33 Billion would be required by way of investment in new electricity production facilities (mainly wind and solar), grid infrastructure and system services.

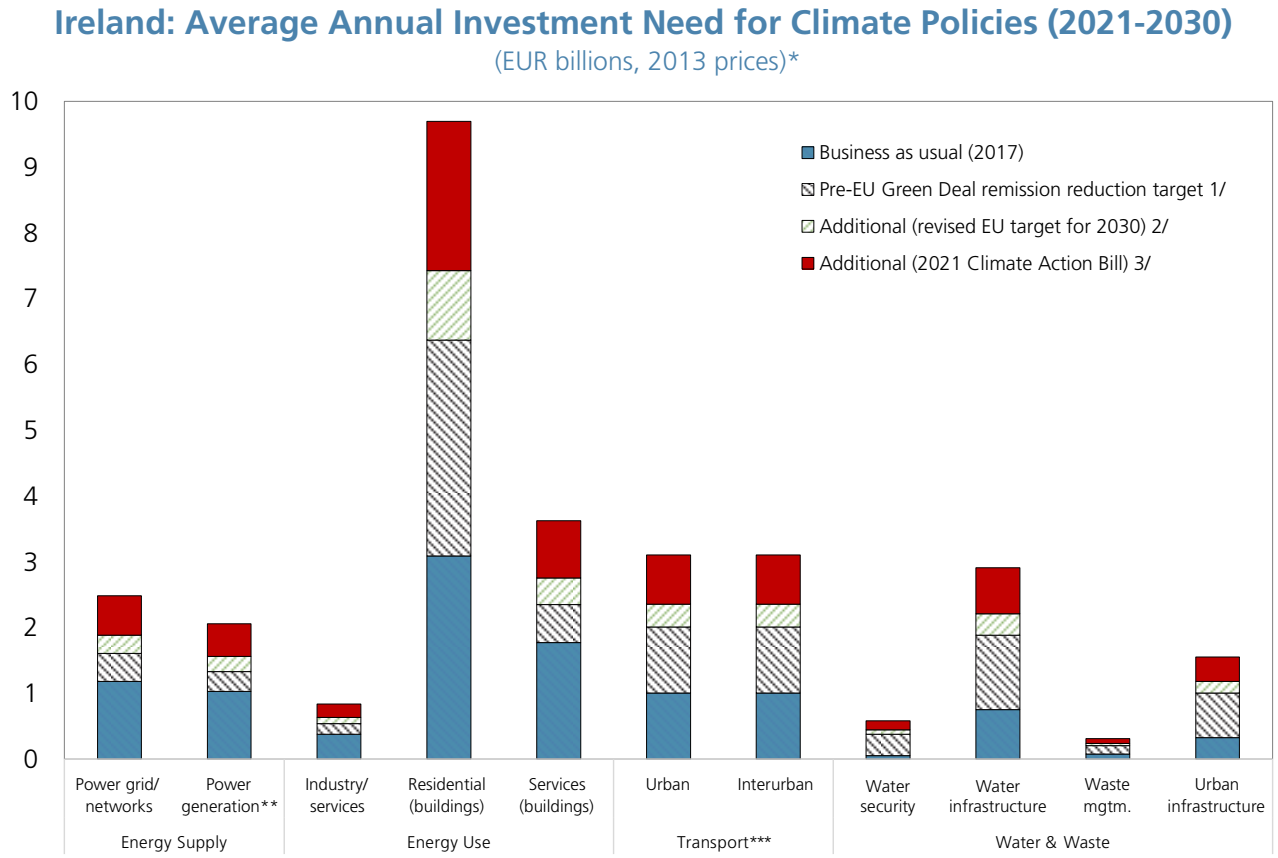
The additional cost necessary at the customer end (heat pumps, insulation upgrades, EV charging points etc) were estimated at a further €30 Billion bringing the total estimate for the electricity sector to €63 Billion.

The Academy has on several occasions called for a more detailed financial analysis of all aspects of the decarbonisation programme required to achieve the current 2030 targets.

It is a matter of considerable concern to the IAE that such a comprehensive analysis remains outstanding.

In June 2021, the IMF provided some insights into the likely required investment, although once again signalling strongly that the estimate was subject to considerable uncertainties.

5 http://iae.ie/wp-content/uploads/2017/07/IAE_Report_-_Irelands_2030_Greenhouse_Gas_Emissions.pdf
6 https://eaireland.com/wp-content/uploads/2020/11/Our-Zero-e-Mission-Future-Report.pdf



Sources: Central Statistics Office (Ireland); European Commission; European Investment Bank and IMF calculations

Figure 1: IMF Country Report No. 2021/124, June 10, 2021[7]: Box 1. Investment Need for Climate Policies (2021–30)

Figure 1 indicates a total 10-year energy supply (generation and networks) investment requirement of approximately €45 Billion. Energy use (heat pumps, building upgrades etc) investment is estimated at €170 Billion giving a total of €215 Billion for the energy sector. (The estimates do not include sectors like agriculture).

The IMF suggests that 30% of this expenditure (approximately €70 Billion) would be public capital expenditure. Putting in place proper planning for this level of expenditure both public and private becomes more important with every passing day.

A comprehensive analysis would:

- Establish a detailed capital investment programme for the next decade.
- identify the cost of such a programme (and the likely sources of capital).
- Confirm the savings (in fuel for example) resulting from the investment.
- Model ongoing operational and maintenance costs.
- Identify the impact on energy consumers and taxpayers.
- Identify any significant barriers to the investment programme.
- Suggest remedial actions (changes to planning legislation for example) in advance.

The CRU has already confirmed[8] that this programme will lead to increased electricity prices. Is this a 5% increase, a 25% increase or a 95% increase?. It really is important that the necessary analyses are carried out without delay, that likely electricity price increases are estimated

7 https://www.imf.org/en/Publications/CR/Issues/2021/06/15/Ireland-Selected-Issues-460785
8 Oireachtas Committee records July 2021

and that the corresponding benefits are identified. If, for example, finance raised using increased carbon taxes is, as has been suggested, returned directly to consumers, then such finance will not be available for the public element of the expenditure identified by the IMF. What then will be the source of this finance?

If such analyses continue to be delayed and the cost of important choices are not conveyed to the public generally, it is the Academy view that social trust and support for the energy transition will steadily fade, and the ambitious targets set by Government will not be achieved.

2.2 System Reliability and Generation Adequacy

This issue was thoroughly discussed in the Academy paper published in March 2021. While a major move to offshore wind and solar generation is envisaged by 2030, all studies to date indicate that a large amount of gas fired generation *capacity* (the maximum power output that the electricity generators can physically produce, measured in megawatts (MW)) will still be required at that date. The most recent EirGrid study indicated that gas fired *capacity* would have to increase by 1000MW beyond what is currently available on the system if system reliability standards are to be maintained.

It is important to understand that the requirement is for *capacity* rather than *energy* (the total amount of electrical energy delivered over an extended time period, measured in megawatt-hours (MWh)). This new gas-fired plant will run with a high level of intermittency. The average gas consumption will fall (MaREI estimate by 20%) but peak gas consumption will rise. The consequences for gas supply security are discussed in the next section.

It is worthwhile looking at an example of the system demand and generation mix for a specific week. The chart below shows the demand every 15 minutes for the first 23 hours of the 9th of July 2021. Also shown on the chart is the contribution from wind generation.

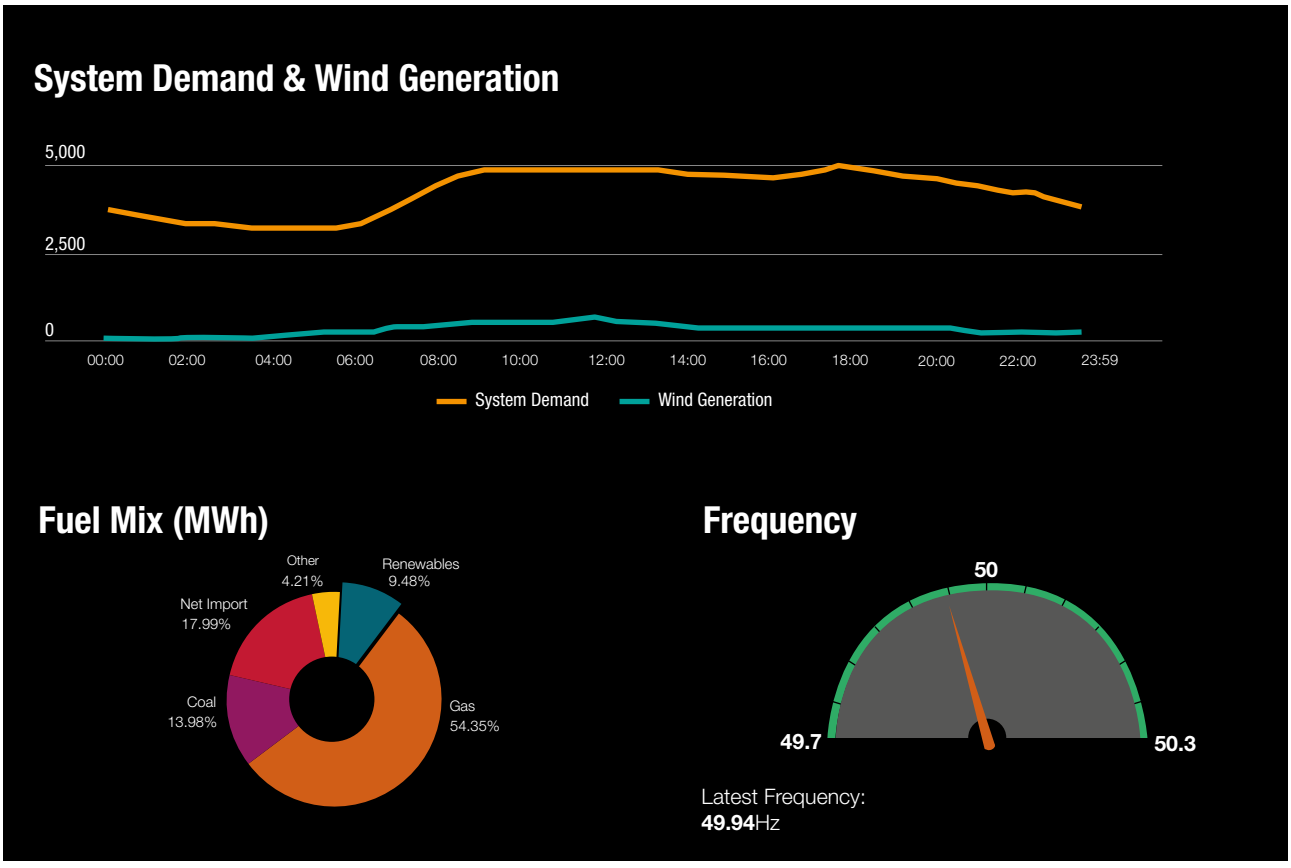


Figure 2: EirGrid Dashboard 9th July 2021.

The peak demand occurred at 17.45 and measured 4,930MW. Wind generation at the time of the peak amounted to 281MW or 5.7% of the total. Daily figures for the week beginning Monday 5th July are as tabled below:

Date	Peak Demand MW	Wind Generation at peak (MW)	Wind generation as a % of peak demand
9 July 2021	4930	281	5.7
8 July 2021	5229	57	1.1
7 July 2021	5107	709	13.9
6 July 2021	5284	1369	25.9
5 July 2021	5121	291	5.7

The contribution of wind generation to the system peak varied from a high of 25.9% on the 6th of July to a low of 1.1% on the 8th of July –the average for the week was 10.5%. It is quite obvious from this example that large amounts of conventional backup generation must be available if the system operator is to "keep the lights on".

The EirGrid dashboard also shows the *energy* contribution from each generation source over periods of a day, week or month. The data tabled below is for July 9th.

Gen Source/ Period	Renewables (%)	Coal %	Gas %	Other %	Net Imports %
Day 9th July	9.5	13.4	54.4	4.2	18.0
Week ending 9th July	16.3	15.8	51.5	4.0	12.4
Month preceding 9th July	24.6	12.3	50.0	6.1	7.1

For the period of the week ending the 9th of July, renewables contributed 16.3% of total system demand. Gas fired plant contributed in excess of 50%. Rather surprisingly, Moneypoint coal fired plant, scheduled for decommissioning in a little over 4 years, supplied almost 16% of system demand. In part this was due to the fact that Western Europe experienced significantly lower than normal wind speeds[9] during the period January to July 2021, thus reducing the capacity to import from the UK and highlighting the fact that only fossil fuel or nuclear-powered generation can cover for such eventualities.

The major expansion of wind generation envisaged over the next decade will undoubtedly increase the percentage of *energy* from renewable sources over that time period. The Target is 70% renewable energy by 2030.

But it is really important to understand that the *capacity* increase in renewables will not be accompanied by a *capacity* decrease in conventional plant. Rather conventional plant (typically gas fired) capacity will have to increase significantly in order to meet system demand at times of low wind generation and maintain reliability standards as older oil and coal fired plant is retired.

The CRU has recently confirmed at an Oireachtas Committee meeting[10] that new investment is *now* required for *at least* 2,000MW of gas fired capacity.

Electricity markets which primarily remunerate such generating plants for energy (electricity) supplied are not appropriate for this situation, despite reservations at EU level. The market must support the provision of *capacity* rather than *energy*. The CRU has indeed introduced a capacity auction process, so that the power system may acquire the necessary generation, battery storage capacity and demand response capability. The auctions are run by EirGrid on the CRU's behalf.

9 https://www.bloomberg.com/press-releases/2021-08-12/-rsted-a-s-interim-report-for-the-first-half-year-of-2021-significant-us-offshore-capacity-awarded-and-several-strategic

10 Oireachtas Committee records July 2021

Much of the existing gas fired plant (Combined Cycle Plant –CCGT) is designed for base load operation and is unsuited to the type of intermittent operation now required to balance intermittent renewable generation. In fact, the frequent ramping up and down of the output of such plant is likely to have serious consequences for its reliability.

It should come as no surprise therefore that the availability of this plant has steadily fallen over the recent past and Forced Outage (FO) rates have increased significantly as more and more intermittent generation is accommodated on the power system.

This has led to a rapid rise in the number of "amber alerts" issued by EirGrid in the last six months. It has also led to the unusual situation of all three units at Moneypoint coal fired plant (to be fully decommissioning by 2025) scheduled to operate at maximum capacity at times over the summer of 2021 in order to ensure system reliability.

Because of the energy transition, the risk of system outages has significantly increased and, again this has been confirmed by the CRU at the recent Oireachtas Committee meeting.

At the end of June 2021 authorities announced that 200MW of *"Emergency Generation*" would be *leased* for six months in order to meet the upcoming peak winter demand. This generation would be located at an ESB site in North Wall, Dublin. Work commenced to prepare the site.

The failure of the normal auction process to provide adequate system capacity is a very worrying development. Traditionally, large scale generation rental is only used in developing countries with poor transmission infrastructure; installed following major catastrophes or used in isolated industries such as mining.

The fact that a developed economy like Ireland, which historically has had an exceptionally reliable power system, suddenly had to propose leasing hundreds of MWs of generation on a temporary basis to meet peak demand will certainly be perceived negatively by energy intensive industries considering investment in Ireland.

The decision to proceed with *"Emergency Generation"* led to a legal challenge by another commercial party in early August 2021. A few weeks later the contract for the *"Emergency Generation"* was cancelled.

The obvious failure of the "normal process" operated by the CRU for acquiring generation capacity is a matter of considerable concern to the Academy. This concern is only compounded by the major decision in respect of the addition of *"Emergency Generation"* followed in a matter of weeks by its sudden reversal.

2.3 Strategic Gas Supply

The Academy report of March 2021 clearly articulated the need, not just for gas fired generation capacity, but for the consequent reliable supply of natural gas which will be required to meet peak gas fired demand.

With the possible exception of a future geological storage capability in one location at Islandmagee in Co. Antrim, Ireland has now no gas storage capability. By 2030 Ireland's domestic gas production will have ceased and the country will have to import all its natural gas requirements through the UK.

By that date also UK North Sea gas supplies will have greatly reduced, and the UK will import up to 75% of its natural gas requirements. Against this background the Academy has pointed out the strategic vulnerability of Ireland's gas supply (and consequently its electricity supply) as the country will lie at the end of a long supply chain.

Other Western European countries in this position have all ensured strategic supplies by encouraging the construction of Liquified Natural Gas (LNG) importation facilities. The Academy believes that the Government should urgently consider incentivising the construction of such a facility on the Island of Ireland.

Concern has been expressed about the possible import of gas produced primarily by using hydraulic fracturing techniques ("fracked" gas). The Government can easily condition the license of such an LNG facility to exclude the importation of such gas. The majority of natural gas traded internationally in the world is not "fracked".

At present the only international source of "fracked" gas is the US. In 2020 just over 20% of Europe's LNG imports originated in the US. Since "fracked" gas is imported into the UK, Ireland is already using such gas.

2.4 Progress on transmission investment

In its report of October 2020 outlining the challenges inherent in expanding Ireland's transmission system, the Academy drew attention to three urgent projects:

- North-South Interconnector
- Laois 400kV substation
- Dunstown – Woodland 400kV circuit

The North-South interconnector was proposed in 2005 and scheduled for commissioning in 2012. It would make a major contribution to system operation as well as improve the efficiency of the Single Electricity Market (SEM).

There appears to be little further progress on the project over the past 12 months. Given the evident social (and often political) opposition to the project, the Academy wonders if the time has not come for a more direct intervention in the project permitting process by Government authorities on both sides of the border.

The Laois 400kV substation is critically important as the first connection into the southern 400kV line from Moneypoint to Dublin. It was first proposed in 2008 with a commissioning date of 2014. It is fully permitted, and the courts have dismissed any objections.

Yet there seems to be little progress on the project. Is it likely to be abandoned?

The news is better on the important Dunstown – Woodland 400kV connection where EirGrid has gone through a detailed consultation process and decided to underground the complete circuit.

While the Academy is pleased to recognise the progress made, the major step of undergrounding 400kV infrastructure is not without consequence. The Academy is of the view that the transmission investment programme must now be updated to reflect the likelihood that, in the future, much more of the high voltage transmission system will be undergrounded with accompanying increased costs.

2.5 Data Centre Supply

The Academy published a paper in August 2019 drawing attention to likely future problems arising from the rapidly increasing electricity demand from data centres. Earlier this year EirGrid, in its consultation document, identified the same problems and suggested that data centres should henceforward be located close to areas with surplus generation. More recently the Commission for Regulation of Utilities (CRU) has issued a consultation paper on the issue.

The Academy concurs with EirGrid's view. In particular the Academy believes that:

- Major data centre expansion in Dublin would require a level of new transmission investment and construction that is no longer socially acceptable. Such expansion should not be permitted.
- Discussion should take place between EirGrid and the IDA with a view to identifying locations with adequate power supplies and suitable digital connectivity (fibre capacity, low latency etc). Such locations should be established as new data centre hubs.
- The pricing arrangements for electricity supplies to data centres should be adjusted so as not to involve any subsidies which might ultimately be paid for by the general electricity consumer.
- All new data centres should be required to enter into Corporate Power Purchase Agreements (PPAs) with newly developed Irish based renewable energy facilities. The terms of those contracts should be regulated to ensure that data centre expansion is not increasing Ireland's GHG emissions.
- Efforts should be made to harness, for the benefit of overall power system security, the very considerable amount of standby generation at existing Dublin data centres.
- When upgrade opportunities arise, the possibility of using larger gas fired standby units in preference to smaller diesel fired units should be actively encouraged. The Academy recommends that future standby generation facilities should be made available for dispatch by EirGrid when circumstances warrant such action.

If the above conditions are met, then data centre expansion in support of Irish Information technology companies remains perfectly acceptable. The Academy is concerned that even though this issue was identified several years ago, it is only now that the CRU has sought views on overcoming the obvious problems.

Recently, EirGrid has indicated a significant further increase in possible data centre demand by 2030. It will be important to monitor the reality underpinning these requests. The Academy is of the view that much of this demand may be highly speculative.

Disclaimer

The members of the Taskforce and the contributors participated in extensive discussions in the course of a series of meetings, and submitted comments on a series of draft reports. Its contents convey the general tone and direction of the discussion, but its recommendations do not necessarily reflect a common position reached by all members of the Taskforce, nor do they necessarily reflect the views of the organisations to which they belong.

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