Report

Independent Review on the Security of Electricity Supply

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1. Introduction

I was engaged on 8 August 2022 by the Department of the Environment, Climate and Communications (DECC) on behalf of the Minister to conduct a review with the following terms of reference:

Having regard to the fact that Ireland faces an electricity generation capacity shortfall for the winters of 2022/23 to 2024/25 (a)to identify factors which have contributed to the capacity shortfall, including the possible role of the growth in demand for data centres and the associated policy; (b)to identify factors which contributed to any underestimation of the risk of capacity shortfall; (c)to identify factors associated with respective roles and responsibilities which may have contributed to this situation; (d)to identify learning which may be relevant to strengthening policy, capacity, governance and operational effectiveness in this area; and (e)to identify any further technical analysis which may be helpful in this regard.

The Department contracted with the Institute of Public Administration to provide administrative support to me during the conduct of this review. I am grateful to Ms Ashling Newberry of the IPA for her efficient administrative support during this review.

It was agreed that, in order to conduct the review, I would be given access to all relevant documentation held by the Department, by the Commission for Regulation of Utilities (CRU), by EirGrid and by other relevant departments and agencies where required. It was also envisaged that I would engage with representatives of these entities and other relevant parties as I might consider appropriate.

The issues which I was asked to review predate the broader challenges to energy security which have arisen from the invasion of Ukraine by Russia and those wider issues have not been addressed in this review. I have, however, taken account of the response to those events in formulating my conclusions and recommendations.

Subsequent to the commencement of this review a public consultation was initiated by the Single Electricity Market Committee on issues relating to the operation of the market, especially the capacity market, based on the report of a review which had been commissioned from EY Consultants by the Commission for Regulation of Utilities. Later, a public consultation was initiated by the Department on security of primary energy supply (natural gas and electricity) against the background of a report which it had commissioned from CEPA consultants. I took account of the scope and focus of these separate exercises in the conduct of my review.

In order to fulfil my terms of reference, I considered that it would be appropriate to examine contemporaneous records to consider how the development of the capacity shortfall unfolded and was understood, and to whatever degree anticipated, by those with relevant roles and responsibilities. To that end, I sought and was given access to extensive records by the Department and by the Departments of the Taoiseach, Finance, Public Expenditure and Reform, and Enterprise Trade and Employment. These included records of a confidential nature, many of which would not be discloseable under Freedom of Information criteria. I also invited the CRU and EirGrid to provide me with such records as they considered relevant to my terms of reference. I am grateful to them for the material which they made available, some of which was of a confidential nature.

At my request, I met with the Commissioners of CRU, with the Chair and Chief Executive of EirGrid and with officials of the Department. I am grateful for their very helpful cooperation in my review.

I presented an interim report (8 November 2022) describing the approach I had taken to the conduct of the review and my intention to furnish a substantive report by the end of November (30 November 2022). I requested that the Department fact-check the final report as submitted (4 Jan 2023), including identifying any issues of commercial sensitivity and I have approved the minor amendments proposed which clarified or corrected statement of facts and did not alter my conclusions which remain unchanged.

June 2023

2. Roles and Responsibilities in the Electricity Market

Before turning to an analysis of the issues arising from the unfolding of the crisis in the electricity market, it may be helpful to recall the roles and responsibilities of different entities involved in that market.

2.1 European Union

From a policy perspective, the design and operation of the electricity market in Ireland reflects European policy as it has evolved over recent decades. This influence was first expressed in the context of the European Single Act of 1986 which sought to promote economic growth through the integration and opening to competition of key sectors of the European economy. This was the guiding principle reflected in the First Energy Package adopted in 1996 in respect of electricity and which was required to be transposed by member states by 1998. It provided for a gradual convergence of different electricity market designs through harmonisation of technical rules affecting cross-border trade. In 2004 the European Commission adopted proposals to support what was known as the 'target model' designed to accelerate the integration of markets. This was followed by directives to increase competition, with stronger requirements for the unbundling of electricity businesses. The European Third Energy Package promoted greater market integration through a series of regional integration projects designed to foster cross-border integration of adjoining electricity markets, while producing harmonised technical standards embodied in mandatory codes.

The Clean Energy Package adopted in 2019 comprised a set of directives and regulations to promote energy efficiency, an ambitious deployment of renewable energy and a fair deal for consumers. It provided specific guidance on important market design issues, including the framework for the role of demand-side measures in the electricity market.

In addition to its role in promoting competition, the European Union has also shaped the drive for greater sustainability in energy as a key to decarbonisation of the European economy. The EU framework for protection of the environment has shaped national environmental

legislation governing limits on emissions from industrial plants, including electricity generators.

The specific rules which govern the operation of the electricity market in Ireland, which is an all-island market, were approved by the European Commission as required by regulation. That approval will require to be renewed over coming years against the backdrop of evolving European standards and expectations. The transformative impact on energy markets of the invasion of Ukraine by Russia, as a result of the decision to decouple the European energy market from Russian energy supplies, has prompted a new dynamic to frame a new European strategy to secure energy sustainability, security and cost competitiveness in a radically different context.

2.2 Department of the Environment, Climate and Communications

The development of policy and legislation regarding the electricity market in line with European requirements is the responsibility of the Minister for the Environment Climate and Communications and his Department. The Energy White Paper of 2015 provided for transition to a low carbon energy system, in line with European requirements, in part through a commitment to 40% renewable electricity generation by 2020, while the Single Electricity Market established on the island of Ireland in 2007 was restructured in 2018 to comply with EU electricity market rules.

A key responsibility of the Department is engagement in the development of European policy on energy and ensuring that its application to Ireland reflects the particular characteristics of the Irish market, such as limited electricity interconnection. The Department was responsible for developing a Renewable Electricity Policy and Development Framework and published an Offshore Renewable Energy Development Plan in 2014. The Department had responsibility for developing measures under the National Adaptation Framework, pursuant to the Climate Act 2015, which provided for the ending of coal-fired electricity generation by end 2025 and targeted 70% renewable electricity generation by 2030. Targets for decarbonisation of electricity supply were confirmed in the Climate Action Plan 2019 which identified a key role for offshore wind. This was updated in the Climate Action Plan 2021 to a target of at least

5GW of offshore wind by 2030. The target for renewable generation of electricity overall was also increased up to 80% by 2030.

Against the background of compliance with European energy requirements, the Department's objective has been to ensure a secure, competitive and sustainable energy system which supports the transition to a low carbon economy, while minimising costs. A particular challenge over recent years was to secure a new bilateral framework for the continuation of the Single Electricity Market after Brexit.

The Department is responsible for the legislation which governs the operation of the electricity market and, in that context, exercises corporate governance functions in respect of statutory entities in the electricity market, including the Commission for Regulation of Utilities and EirGrid, whose responsibilities are outlined below. The Department also exercises shareholder functions in respect of the Electricity Supply Board and oversees its investment strategy and commercial performance in line with the Code of Practice for the Governance of State Bodies. Responsibilities in respect of the ESB are performed internally within the Department separately from the discharge of the Department's responsibilities in respect of the operation and regulation of the electricity market.

The planned phasing out of electricity generation from oil, peat and coal and much greater penetration of intermittent renewable resources meant that there would be a greater dependence on natural gas fired generation to ensure security of supply when the wind didn't blow. In that context, and having regard to the significance of natural gas for heating purposes, the Department identified in 2020 a need for a strategic review of the security of energy supply of Ireland's electricity and natural gas systems with a focus on the period to 2030, in the context of ensuring a sustainable pathway to decarbonisation by 2050.

The Department supports the Minister in his policy and legislative roles and, in that context, engages in cross-departmental fora and processes which reflect the wide impact of energy policy and the importance of collective government responsibility. It supports the Minister in his membership of the Cabinet Committee on the Environment and Climate Change and contributes to the development of whole-of-government programmes in respect of, for

example, climate policy and spatial planning. In addition to developing proposals for relevant legislation, the Department leads on the preparation of relevant statements of government policy, such as on the Importation of Fracked Gas and on the Security of Electricity Supply, both published in 2021.

2.3 Commission for Regulation of Utilities

The CRU was originally established in 1999 as the Commission for Electricity Regulation and had its remit broadened to regulation of the natural gas sector in 2002 and further broadened in 2017 to function as the regulator protecting the public interest in water, energy and energy safety, as reflected in its current title. The CRU has statutory powers in relation to the operation of the all-island single electricity market.

CRU operates under the aegis of the Department of Environment Climate and Communications (DECC) for all of its activities other than in respect of water services, which come under the Department of Housing Local Government and Heritage. The CRU is by law independent in the performance of its functions. In line with the Code of Practice for Governance of State Bodies, CRU operates to an Oversight Agreement with the two Departments. This Agreement reflects the terms of the Government Policy Statement on Economic Regulation 2013, which requires regulators to produce strategy statements, annual output statements, and annual reports and to agree with the relevant department appropriate performance indicators which relate to the fulfilment of sectoral legislative mandates and not to individual regulatory decisions or determinations.

The Oversight Agreement with DECC requires that the Annual Report of CRU should include confirmation that an appropriate assessment of CRU's principal risks has been undertaken, including a description of those risks as appropriate, and associated mitigation measures and strategies. The CRU also produces an annual Work Plan and meets quarterly with the Department to review governance, compliance with the Code and other relevant matters. CRU is obliged by statute to account for the performance of its functions to a Joint Committee of the Oireachtas whenever so requested, and to have regard to any recommendations of such Joint Committee relevant to its functions.

The CRU Strategic Plan 2019-2021 gave as its key objectives to deliver sustainable low carbon solutions with well-regulated markets and networks; to ensure compliance and accountability through best regulatory practice; to develop effective communications to support customers and the regulatory process; and to foster and maintain a high-performance culture and organisation to achieve its vision. In respect of the economic regulation of energy, CRU's objectives were to protect the interests of energy customers, to maintain security of supply and promote competition covering the generation and supply of electricity and the supply of natural gas. In its Strategic Plan 2022-2024 CRU has named its priorities as ensuring security of supply, driving a low carbon future, empowering and protecting customers and enabling its people and organisational capacity.

Under section 9 of the Electricity Regulation Act 1999 and the European Communities (Internal Market in Electricity) Regulation 2005 (SI No 60/2005) CRU has a statutory duty to ensure security of supply and that all reasonable demands for electricity are met. It has statutory powers to control the construction of electricity generation stations and electricity interconnectors, as well as to licence those supplying electricity to a final customer. CRU determines the Security Standards by reference to which necessary generation capacity is planned and operated in the context of anticipated demand.

2.4 Single Electricity Market

CRU regulates the all-island wholesale single electricity market with its counterpart in Northern Ireland, the Utility Regulator (UR), through the Single Electricity Market Committee, the joint decision-making body established in 2007 to be responsible for all matters relating to the all-island wholesale electricity market. Its principal objective is to protect the interests of consumers of electricity by promoting effective competition between those engaged in, or in commercial activities connected with the sale and purchase of electricity through the SEM. The Committee comprises representatives from CRU and from UR, along with two independent members. Formally, it is established as a subcommittee of the CRU and, under matching provisions, as a subcommittee of the UR. When the Committee meets it is formally a meeting of the two subcommittees meeting simultaneously. A Memorandum of Understanding concluded between CRU and UR provides that the two bodies will maintain and facilitate effective and beneficial cooperation and collaboration so as to ensure the

effective delivery of both joint and separate statutory remits. In this context, the Regulatory Authorities work on all-island transmission issues, including harmonised transmission investment and outage planning, Grid Code requirements, transmission tariffs and ancillary services and related payments.

The SEM is designed to provide three distinct revenue streams in relation to services provided by market participants. The Energy Trading Arrangements enable wholesale energy trading which is responsible for the majority of revenue and cost for most market participants. A number of markets operate, each spanning a different trading timeframe - forwards, day ahead, intraday and balancing markets - which are designed to enable increasing levels of competition to place downward pressure on prices, while seeking to ensure that the supply of power matches demand.

The second pillar of the SEM is the Capacity Market in which a Capacity Remuneration Mechanism, introduced in its present form in 2018, enables generators of electricity - effectively gas fired generators - to recover their fixed costs, while aiming to ensure that there is enough capacity to meet demand and that this capacity is purchased at a competitive price via auctions. In an auction, participants specify the amount of capacity (MW) being offered and the price sought for that capacity. Bids are arranged from lowest to highest price until the capacity requirement for the relevant year is satisfied. The market clearing price at which this required level of capacity is met is paid to those who bid at or less than the clearing price. Auctions for capacity are run at least one year before the capacity is required, while auctions for capacity required four years later are designed to encourage new investment by providing a clear and known revenue stream. Generators which fail to deliver when required the capacity they have been awarded by auction are subject to a financial penalty.

The third pillar of the SEM is the DS3 Programme (Delivering a Secure, Sustainable Power System), which reflects the challenges of operating the electricity system in a secure manner while achieving targets for electricity generation from renewables. This programme has facilitated greater penetration by renewables in line with ambitious policy targets. In addition to the benefits from a sustainability perspective, increasing rates of generation from renewables support lower wholesale energy prices.

Renewable energy generation is supported through the Renewable Electricity Support Scheme (RESS) which was introduced in 2019 to support through auctions the targeted increase in the renewable energy resource.

The institutions of the SEM are operated under the direction of the SEMC by the Single Electricity Market Operator (SEMO) which brings together the two Transmission System Operators in Ireland and Northern Ireland, as described below.

2.5 EirGrid

The electricity transmission systems in Ireland and Northern Ireland consist of high voltage networks for the transmission of bulk electricity from generation plants to licensed regional electricity distributors and direct to some large energy users. EirGrid is licensed by CRU to act as the Transmission System Operator (TSO) and so is responsible for operating and planning the transmission grid. The grid is owned by ESB Group whose subsidiary, ESB Networks, is responsible for its maintenance and construction, as well as being the licensed operator of the electricity distribution system in Ireland. In Northern Ireland, SONI (System Operator Northern Ireland) - which is owned by EirGrid - is licensed to act as TSO, while the transmission and distribution networks are owned by Northern Ireland Electricity Networks (NIE Networks), which in turn is owned by ESB.

EirGrid is a commercial State body which is accountable to the Minister for the Environment Climate and Communications, in line with the Code of Practice for Governance of State Bodies. In its Strategy 2020–2025, EirGrid states that its purpose is to transform the power system for future generations by leading the island's electricity sector on sustainability and decarbonisation. Its key objective in attaining that goal is to operate, develop and enhance the all-island grid and market.

Arising from its responsibility for planning the transmission system, EirGrid has been addressing the technical challenges of accommodating high levels of renewables, primarily wind, which, unlike older fossil fuel-based generators, are not synchronised at the same frequency when connecting to the grid. These and other challenges to the transmission and distribution systems were addressed in Shaping Our Electricity Future Roadmap which was

published in 2021 following extensive public consultation. This identified detailed actions that are required in order to deliver on targets set for 2030. The Government's Policy Statement on the Framework for Ireland's Offshore Electricity Transmission System provides that EirGrid will be both the System Operator and asset owner of the offshore transmission system and will be responsible, within a regulated framework, for facilitating the ambitious goals for the offshore renewable resource.

EirGrid has a statutory obligation to publish forecast information about the power system, in particular regarding generation adequacy, which is a measure of the capability of the electricity supply to meet electricity demand on the system. A similar obligation applies to SONI as a condition of its licence to operate as the TSO in Northern Ireland. This obligation is met through the publication of an annual Generation Capacity Statement (GCS) setting out the likely balance between electricity demand and supply over the following 10 years. The GCS is prepared jointly by EirGrid and SONI and provides forecasts in respect of each jurisdiction separately as well as for the all-island market. This provides an important signal to participants in the electricity market and informs the Regulatory Authorities and the SEMC in determining the generation capacity to be sought through CRM auctions. In addition, EirGrid and SONI publish an annual Winter Outlook which assesses the capacity margin between supply and demand for the winter period, including the peak level of demand which the system is likely to face. EirGrid is required by regulation to assess the short, medium and longer term outlook for security of power supply and to report to CRU on matters relating to security of supply.

3. The Generation Capacity Shortfall

3.1 Introduction

Society expects that electricity supply will be available whenever required to support all aspects of economic and social life. There is also an expectation, reflected in public policy, that it will be available at reasonable and affordable prices. It is also a requirement of public policy that electricity should be generated in a way which is sustainable and consistent with the urgent need to decarbonise our energy system, as a critically important element of society's response to the climate crisis.

The wholesale electricity market, which is a Single Electricity Market for the island of Ireland, is expected to operate so as to enable those three dimensions of security of supply to be achieved. The structure of the electricity market is considered in more detail below. A fundamental principle of the market design is that there will be a high level of assurance that electricity will be available to meet all reasonable demand.

There is little scope for dispute regarding the nature of the generation capacity shortfall which began to be identified in 2020: there was a sharp increase in the perceived risk that electricity supply would not be available to meet market demand, at least at certain times and in certain circumstances.

It is important to note that the system is not designed to give absolute certainty that there will be no shortfall in supply of electricity in any circumstance. The market operates to a reliability standard which is a statement of an accepted level of risk that all demand might not be met for a short period each year. It is expressed as the Loss of Load Expectation (LOLE) which means the number of hours per annum in which, over the long-term, it is statistically expected that supply will not meet demand. In Ireland, the LOLE, is eight hours per year. The risk that demand may not be met is mitigated by the role of the transmission system operator – EirGrid in Ireland – in actively managing the electricity system to balance supply and demand on a continuing basis. When the margin between electricity supply and demand becomes particularly tight EirGrid may issue a System Alert, which communicates the potential for temporary electricity supply issues in the near future and signals to all generators of electricity

to make their facility available for use. A System Alert is normally terminated without incident when an acceptable margin between electricity supply and demand is restored. However a System Emergency State may be issued by EirGrid if there is a high risk that not all electricity demand can be met and may require implementing controlled outages or a temporary reduction in supply for some users.

Each year, the electricity transmission system operators - EirGrid in Ireland and SONI in Northern Ireland - publish an outlook for electricity generation capacity and demand for the following ten years in both jurisdictions and for the Single Electricity Market as a whole. In addition they publish an annual Winter Outlook for expected electricity demand and the capacity margin - that is the excess generation and interconnection available to meet peak electricity demand.

3.2 Prelude to Crisis

The All–Island Generation Capacity Statement 2019–2028 noted that demand for electricity in Ireland was expected to increase significantly due to the expected expansion of many large energy users, primarily data centres. Taking account of generation capacity which had been successful in auction for the All-Island system for 2022/23, and the expected delivery of the North South Interconnector in 2023, EirGrid estimated that there would not be adequate generation capacity to meet demand (in all but a Low Demand scenario) to the mandated standard of security from 2026, assuming the closure of the Moneypoint coal-fired generator in 2025 in accordance with European and Irish Government environmental requirements. It was noted however that should any other plants close, for example due to emissions restrictions, or if there were unavailability of the conventional generation fleet as was seen in 2018, deficits could arise earlier. A similar outlook was provided for the All-Island market. This was a signal that further generation capacity would be required by 2025/6.

3.2.1 COVID interrupts Plant Maintenance 2020

The Winter Outlook 2019/20 showed an expectation that there would be adequate capacity to ensure a secure supply of electricity over the coming winter period, with sufficient capacity margin in both jurisdictions to meet their respective peak demands, even though there could be periods of low capacity margin if generators were unavailable during low wind conditions. This relatively benign position was confirmed in March 2020 when EirGrid noted that the outlook for security of supply for the coming period was within acceptable standards. However, restrictions imposed in that same month in response to the COVID-19 outbreak constrained routine maintenance work on generation plant, as well as affecting international supply chains for parts and equipment. A number of conventional generators did not operate through 2020 as normal in order to conserve running hours so they would be more likely to be available during the winter season when demand is higher. This Covid-related constraint compounded the problem of declining availability of ageing thermal plant over recent years. Some of this plant was facing closure in the near term as a result of environmental obligations and so the cost of maintenance could be commercially challenging. Other plants operated with restricted available hours due to the need to comply with emission standards. In the event, forced plant outages reached 24% of system availability in October 2020.

In the Winter Outlook 2020/21, EirGrid and SONI expected there to be a significant All–Island capacity margin for the coming winter. However, it pointed out that if the high generator forced outage rates that had been experienced over the past year were to continue over the winter period there would be a risk of System Alerts, particularly when renewable generation (principally wind) was at a low output and support was not available from Great Britain across the interconnectors.

In the event, the known problem of forced outages of conventional generation was exacerbated by the unexpected forced outage of the significant and relatively modern generator at Power Plant A in early December 2020, which was followed by the unexpected failure of one of the Power Plant B generators in late January 2021. In addition, record demand peaks were experienced during the winter. As a result, system margins remained tight throughout the winter and, as anticipated, there were a number of System Alerts at times of low wind generation, even though, overall, renewables accounted for a record 43% of electricity generated in 2020.

3.3 Crisis Declared 2021

On 1 April 2021 CRU and EirGrid briefed the Minister on the heightened risk to security of supply, in particular from the impact of the loss of output from Power Plant A and Power Plant B, and the need for action to secure temporary emergency generation capacity. The Minister sought monthly updates on the management of the risk, which he asked to be accorded the highest possible priority. This concern was reflected in the issuing by DECC of an Early Warning Report to the Secretary General to the Government on 12 April, in line with standard procedure. The Department was also preparing terms of reference for a review of energy policy including, in particular, security of supply of natural gas both for electricity generation and for final consumers, both commercial and domestic.

EirGrid advised that there was a need to connect a number of mobile modular generation units to the grid in time for the winter season 2021/22 and that preliminary steps had been taken towards securing locations for that emergency generation capacity. The urgency of the situation saw CRU request in early May that the Minister initiate the disapplication of the usual requirement for planning permission by reason of an emergency. This required legislation to amend Section 181 of the Planning and Development Act 2000 which was effected by the Planning and Development (Amendment) Act 2021, introduced by the Minister for Housing, Local Government and Heritage. The expected need for similar emergency action in respect of emissions licensing and other statutory requirements was flagged if the necessary generation capacity was to be in place by winter. The Cabinet Committee on Climate Action was briefed on the situation on 31 May.

In parallel with the securing of emergency generation capacity, CRU recommended that a public policy position on the essential role of conventional generation in ensuring a secure transition to the mandated low carbon electricity supply should be prepared. This would be intended to give clarity to the market and so encourage investment in suitable generation projects over the coming period. Clarity on national policy would also be given to planning authorities, so reducing the risk of planning delays facing such infrastructure. CRU also initiated consultation on a proposed direction to EirGrid that would apply new criteria in considering applications for connection to the grid by large energy users, including data centres.

By mid-June EirGrid had issued a statutory warning that security of supply was threatened, or was likely to be threatened during the coming winter. While Power Plant B and Power Plant A generators were expected to be operational in the early part of the winter, there was a material risk that this would be delayed. Meanwhile, the continuing decline in older generation plant availability had resulted in the daily forced outage rate regularly exceeding 20%. In the context of inadequate operating reserves to compensate for reduced plant reliability, this posed severe risks to security of supply given that wind generation capacity is variable, dropping below 500 MW for about 25% of the time. EirGrid thus confirmed that 200 MW of emergency generation capacity needed to be procured. The urgent identification of possible locations had yielded only one suitable site in the timescale available, at the North Wall in Dublin.

CRU advised the Minister on 16 June that it was satisfied, on the basis of the material provided by EirGrid, there was a likely and substantial risk to security of supply during the coming winter and requested that he give statutory consent to CRU to direct EirGrid to procure the necessary emergency generation capacity. The Department noted that this was likely to cost in the order of €100–150 million, which would be funded through a levy on all electricity customers. Recommending that the Minister give consent, the Department noted that, given the technical challenges, there was no guarantee that the generators would be operational on time. The Minister issued his consent for this procurement on 21 June. In doing so, he conveyed his deep concern and asked CRU and Eirgrid to consider how the situation had

arisen, to review and evaluate the performance of the market structure and regulatory measures, and consider if changes were required.

By early July, while there was greater optimism about the return of Power Plant B and Power Plant A, it was clear that the temporary emergency generation capacity was unlikely to be available in time for winter. In part this was because an assumed capacity to exempt the installation from the need for an environmental impact assessment did not exist. In the event, the procurement exercise was terminated in late July. Optimism by then about the return of Power Plant B and Power Plant A reduced the impact of this setback. Nevertheless, the potential need for demand control measures over the coming winter had led EirGrid to engage with large energy users, such as data centres, to understand if and when they could reduce their demand load in times of system constraint. Such steps would be taken in an emergency in advance of measures impacting on other customers.

At this time, the Department's concern that the operation of the capacity market might not produce the necessary generation capacity over future years, and its growing concern in relation to security of electricity supply were conveyed to CRU and to EirGrid. The basis for concern was confirmed in a report prepared by EirGrid in July 2021 on the outlook for security of electricity supply for the period to Winter 2024/5. In addition to the factors which had materialised to date, and which are referenced above, this report pointed to the significance for capacity margins of the notice of termination of projects given by developers who were due to deliver 513MW of new generation capacity, and the risk that further notices of termination of expected new capacity would be received. This failure of expected new plant to come into operation would mean they would not be available to replace ageing plant which was scheduled to be retired, in line with emissions requirements. Having regard to rising demand, and the potential for the rate of increase in demand from data centres to accelerate, EirGrid concluded that an emergency situation existed for the next three winters. In this context, EirGrid concluded that it would be necessary to find a way of keeping at least some of the retiring generators available to the system. For the period beyond 2025, EirGrid concluded that 2GW of gas-powered, and renewable gas-ready generation capacity would be required by 2030 to ensure a secure and reliable power system which would accommodate ambitious targets for renewable generation.

In late August, CRU presented, as requested, its considered assessment in response to the Minister. It highlighted the steps which had been taken to address the risks arising for winter 2021/22, including measures which might increase the effectiveness of demand side units which had been contracted to commit to reduce demand at short notice, so creating flexibility at times of pressure on supply. CRU confirmed that the difficulty created by the termination of contracted capacity which had been expected to come onto the system would apply for the following four winters. Challenges from the planning process and from environmental controls, as well as delays on the part of equipment vendors, had been blamed by developers for this termination. The outcome of a recent auction represented a significant shortfall in the targeted level of generation capacity to be secured. It was believed that the price established at the previous auction - from which successful capacity was subsequently terminated - was too low to be attractive to developers and a further 'catch up ' auction was planned. EirGrid was recommending the procurement of up to 300 MW of temporary emergency generation for winter 2022/3.

CRU observed that the shortfall which was being forecast by EirGrid for coming years assumed (i) a very high rate of demand growth, (ii) limited to no impact from mitigation measures, and (iii) no new capacity delivered by the capacity auction process. CRU had directed Gas Networks Ireland (GNI) to prioritise supplies to new electricity generation plants awarded capacity at auction and it expected that this would improve the prospects for delivery of new capacity.

CRU emphasised the impact that the retirement of existing generation plant would have on supply, particularly from winter 2024/5. A number of plants were due to cease activity at the end of 2023 when a derogation they had been given to comply with the Industrial Emissions Directive (IED) came to an end. Though difficult, CRU recommended that a further derogation should be sought from the Environment Protection Agency (EPA) to enable them to continue to operate and so justify investment in their maintenance. Any such arrangement, CRU advised, would need to be structured so as to have minimal impact on current market structures or the competitive procurement of new capacity.

CRU reported that the Single Electricity Market Committee (SEMC) was developing proposals for scarcity pricing which would send a strong market signal to reduce demand at peak times, so reducing the need for investment in capacity and easing pressure on capacity margins. It was also developing proposals, at the request of EirGrid, to use conditions for connection to the grid as a means of encouraging new large energy users, especially data centres, to alleviate the demand pressures they create through on-site generation or electricity storage.

For the longer term, CRU indicated its intention to run further auctions for new generation capacity up to and inclusive of 2027, when European State Aid approval for the current market arrangements was due to expire. CRU pointed to the Capacity Mechanism as the only reliable means of securing enduring generation capacity to underpin the transition to the desired high level of renewables in the system. The SEMC intended to review all relevant aspects of the auction process to encourage investor participation, pointing to the confidence that investors should also draw from the directions that CRU had given to EirGrid and GNI to prioritise connections to the grids for new generation capacity. Investor confidence would be boosted further if there were a clear policy statement from Government about its commitment to ensuring delivery of adequate new gas generation as a critical enabler of decarbonisation, including the future adoption of hydrogen. Such a statement would also provide clear guidance for planning and licensing authorities. The planned availability of more electricity interconnection to the island would also ease security of supply concerns in the second half of the decade.

CRU proposed the establishment of a high-level Programme Steering Group to oversee implementation of all relevant measures, with participation from the Department and EirGrid. Around the same time, the Chair of EirGrid recommended to the Minister that a whole-of-system response was required to address the serious challenges to security of supply. This would include developing a plan or pathway to deliver new conventional plant with the characteristics needed for an operable system in line with decarbonisation objectives.

On 29 September 2021 CRU published an Information Paper outlining the Programme of Actions being taken to address risks to the security of electricity supply identified in the Generation Capacity Statement published by EirGrid and SONI at the same time. This Paper

recalled the factors which had contributed to the pressure on capacity margins over recent years, resulting in the issuing of System Alerts during periods of low wind, and the prospect of increasing shortfalls in generation capacity over coming years. The Programme being implemented would seek to deliver 2GW of enduring capacity by 2030 in the form of flexible gas-fired generators, together with interim measures and contingency options to protect security of supply, including the procurement of temporary generation capacity of up to 300 MW for winter 2022/3 and extending the life of older generators, with regulatory permission, until replacement capacity was procured, delivered and operational.

The Government on 1 October considered a report from the Minister on the security of electricity supply in the light of the Generation Capacity Statement. It agreed to revisit the Policy Statement on the Role of Data Centres in Enterprise Policy in the light of proposals for new grid connection arrangements. It also noted planned new Mandatory Demand Curtailment to be applied by EirGrid to large energy users, to the greatest extent possible on a voluntary basis, when low wind was forecast to exacerbate tight capacity margins. The direct and indirect impact of concerns about security of supply, especially on industry and investment, were noted and it was agreed to prepare a Policy Statement on Security of Supply, highlighting the need for new conventional generation capacity and new grid, interconnection and storage infrastructure. That Policy Statement was approved by the Government on 30 November. Its contents were consistent with provisions in the National Development Plan and the Climate Action Plan 2021.

In October, in the Winter Outlook 2021/22, EirGrid published its expectation that the electricity system would enter the Alert State at times of low wind and low interconnector imports and that there was an elevated risk, compared to previous winters, of the system entering the Emergency State due to insufficient generation being available to meet demand. This implied that on average electricity consumers could be without supply for approximately 40 minutes, twice the duration of risk implied by meeting the mandated reliability standard. This was emphasised to be a measure of the risk of that happening, rather than a forecast that interruptions to supply would actually occur. In the event, there was fair winter weather, a somewhat lower level of demand than anticipated, as well as a more favourable generation performance. Nevertheless, EirGrid subsequently reported that available generation would

have been inadequate to meet evening peak demand for 21 days, or 22% of the winter period, had wind generation been low or imports over interconnectors been insufficient.

In November, CRU advised the Department that the prospects for a successful outcome from auctions to secure generation capacity for 2024/5 and 2025/6 were encouraging. Steps were being taken to encourage investor confidence, including offering greater clarity about the level of income that might be earned over the contract period, greater assurance about connection of new plant to the grid, and an increased price cap on allowable auction bids. Environmental requirements on the operation of gas-fired generators were also likely to be less restrictive than previously anticipated. With regard to the operation of the market, CRU highlighted the need for EU approval for any significant changes that might be proposed and therefore the importance of those aspects of the operation of the market which did not require EU approval. The Department was informed that an external review of the performance of the system of auctions to procure generation capacity - the Capacity Remuneration Mechanism - had been commissioned and was expected to be completed in early 2022.

Around the same time, EirGrid advised the Minister that it was working at full speed to implement measures set out by CRU in the Programme of Actions which had been adopted earlier in the year. However, EirGrid advised the Minister and CRU that it did not have confidence that the current auction system, the Capacity Remuneration Mechanism, left unaltered, would enable the delivery of the necessary new generation required to meet ambitious targets for decarbonisation and high levels of renewables by 2030. EirGrid identified a number of shortcomings in the Mechanism and suggested the parameters of changes to be adopted urgently if extremely difficult circumstances over the rest of the decade were to be avoided. In responding, the Minister noted that the capacity auction process was being addressed within the Programme of Actions and that EirGrid's proposals should be examined in that context.

3.4 Crisis Outlook 2022

In March 2022, in a report on Capacity and Required Actions in respect of Electricity Security of Supply for Ireland 2022/3 to 2029/30, EirGrid reported that, despite progress in

implementing the Programme of Actions previously agreed, there was likely to be a shortfall of 300 MW of generation capacity for winter 2022/3, with increased shortfalls in 2023/4 and 2024/5. It reported that emergency generation capacity was not expected to be commissioned by the start of winter 2022, but would be in place for winter 2023. EirGrid characterised the situation as an emergency for each of the following years, such that additional temporary measures would be required until enduring solutions could be put in place. It recommended the procurement of up to 700 MW of additional emergency generation for winter 2023/4, together with the retention of older plant due to be retired.

The outlook for energy supply internationally was dramatically altered by the invasion of Ukraine by Russia. This radically changed context was reflected in the approval by the Government in April 2022 of a National Energy Security Framework, which reflected the EU decision to phase out dependence on Russian oil, gas and coal imports. The Framework was to be implemented by a new cross-departmental Energy Supply Emergency Group to coordinate and oversee national level activity and responses in relation to the impact of the war on energy security.

In May 2022, CRU advised the Department that, while progress was being made in the delivery of additional generation capacity, there were risks to that process. The prospects for improved demand side responses - such as optimising availability of batteries or influencing peak levels of demand - were better, though the overall impact was likely to be modest. CRU considered that the EirGrid estimate of a deficit of up to 700 MW for winter 2023/4 could be excessive in the event of a lower rate of increase in demand, while procuring temporary generation capacity on that scale would be a major cost to consumers. CRU recommended a greater focus on contingency measures to reduce demand, in particular deferring or delaying the ramping up of demand from data centres over the next couple of years. Nonetheless, it concluded that a large quantum of temporary emergency generation should still be procured, in the first instance up to 450 MW by winter 2023/4.

In July 2022 EirGrid received a report which it had commissioned from BDO consultants containing a review of the Generation Capacity Statement and the Capacity Market Processes. This review considered the methodology and content of the GCS which is published annually

by EirGrid and SONI. It also considered the operation of the electricity market structure of which the GCS forms part. The Review made a number of recommendations arising from its analysis. The Review was made available to me in the context of my terms of reference.

In August 2022 the Single Electricity Market Committee invited public comment on a Review of the Performance of the Capacity Remuneration Mechanism for procuring generation capacity for the electricity market. CRU had commissioned this Report from EY Consultants as a background study to support the Programme of Actions on security of supply initiated the previous year. The Review analysed developments in the market and considered factors contributing to the strengths and weaknesses of the CRM. Responses were requested by 21 October and the SEMC stated that it intended to publish a plan of action detailing the next steps on the various recommendations once responses to the Review were analysed and considered.

In September 2022 the Department initiated a consultation on a technical analysis of security of energy supply and options for mitigating risk which it had commissioned from CEPA Consultants. This analysis was concerned with the outlook for the period to 2030, not least in the light of the impact on international energy markets of the invasion of Ukraine by Russia. Over 400 submissions were received when the consultation process closed on 28th October.

In October, the Generation Capacity Statement 2022–2031 again warned that System Alerts were likely in coming years and that there was a pressing need to mitigate the risk of more severe impacts. Reviewing the progress being made on the Programme of Actions initiated by CRU, the GCS assessed that their full implementation - including interim measures to procure 650 MW of temporary emergency generation and the temporary extension of the operation of older generators - would enable the official security standard of supply to be met. In the accompanying Winter Outlook 2022/3, EirGrid warned that there was a high probability of the system entering the Emergency State at times, during periods of low wind and low interconnector imports. As a result there was a risk that consumers could potentially be without supply for approximately four hours over the winter period, very substantially higher than the 40 minutes which was the measure of risk in the previous winter. This reflected in part the trend for increasing transmission peak electricity demand during the winter and also

the continuing challenges to supply, in particular from forced outages of generation capacity. The very tight capacity margins in 2022 had already resulted in system alerts being issued on seven occasions since April.

3.5 Summary

In summary, a shortfall in the capacity of electricity supply to meet forecast levels of peak demand within accepted levels of risk was triggered in 2020 by the impact of Covid restrictions on planned maintenance of generation plant, compounding a growing problem of lack of availability of ageing generators nearing retirement, while the unexpected failure of two large modern generators led to a decision to procure temporary emergency generation. By mid-2021 the imminent loss of older generators from the system and the failure of expected new generation capacity procured at auction to be delivered constituted a critical challenge to security of supply for the next few years. This prompted a crisis response of measures to address both supply and demand, including even greater recourse to temporary emergency generation and a review of the operation of the electricity market.

The extent to which the elements of supply and demand summarised above were or could have been anticipated and avoided is examined in the following sections of this report.

4. Was the Crisis Foreseen?

The previous section described the evolving nature of the crisis in the electricity market over the period since the onset of Covid restrictions in March 2020. The factors which gave rise to the crisis, and the unfolding nature of the appreciation of their impact, were also described. What is of interest is to consider to what extent these factors were known and to what extent the crisis might have been anticipated.

The central importance of security of supply was certainly reflected in policy statements and strategic plans from the key institutions with responsibility for the electricity market prior to 2020. However the Winter Outlook 2019/20 published by EirGrid and SONI stated that it was expected that there would be adequate capacity to ensure a secure supply of electricity over the coming winter period in Ireland and Northern Ireland. Insofar as there was a concern about security of supply in the Department at that time it related to increasing dependence on natural gas for generation to supplement the targeted increase in renewables. This vulnerability had been commented on by the International Energy Agency (IEA) in its country review of Ireland in 2019. This was a risk which the Department in 2020 was preparing to have reviewed through expert analysis as a prelude to public consultation.

4.1 Elements of the Shortfall

The following sections consider the appreciation of the significance of the individual factors which crystallised in the energy crisis of the recent past. Later sections will review the expectation regarding security of supply in the electricity market taken in the round.

(i) Forced Outage of Generation Plant

Clearly, the impact of Covid and the consequent restrictions on movement and trade could not have been anticipated. As noted earlier, this significantly impacted on planned maintenance which in turn negatively impacted on the reliability of generation plant, especially older plant. The forced outage of generation plant was already a growing issue in

the system, increasing every year for the three years up to 2019 when it averaged 10.5%. As a result a small number of System Alerts were issued in 2020.

The failure of the generation plants at Power Plant A and Power Plant B, which between them accounted for 15% of installed thermal generation capacity, was unexpected and significantly exacerbated the problem of reliability of the generation fleet. In that context the capacity shortage was described by EirGrid in May 2021 as due to "substantial plant outages on the system which were neither foreseeable by nor attributable to EirGrid". CRU referred in a later report to 'the unanticipated and increasing outage rates of conventional plant' as a significant factor in the capacity shortfall.

The decision to seek to procure 200 MW of emergency generation capacity was influenced by concern that Power Plant A and Power Plant B would not be operational in time for winter 2020/21. In the event they returned to the system and the procurement process was abandoned. Nonetheless, there were a number of system alerts in Ireland and Northern Ireland in winter 2020/21 reflecting, inter alia, spells of cold weather and a record peak electricity demand.

However, the problem of declining reliability of thermal generating plant continued to be a threat to security of supply. It was known that the trend for declining plant availability reflected the fact that units were nearing their closing date, such that investment in maintenance and performance upgrades would be commercially challenging. The problem of forced outages also reflected the fact that, with increasing levels of renewables, thermal generation plants which had been designed for continuous operation were required to ramp up and down in response to wind availability, with increased risk of breakdown. There was not a sufficient reliability reserve in the system to replace units which were subject to forced outage.

(ii) Exit of Generation Plant

The ending of much conventional generation of electricity was required by Directive 2010/75/EU on industrial emissions and by policy on decarbonisation of electricity. Deadlines for the closure of affected plant contributed to the challenge to generation capacity and, as noted above, a number of plants were terminated early. Of particular importance in this regard is the Moneypoint coal-fired plant where an end to burning of coal by 2025 on environmental grounds was set in 2018. Its significant role in the generation system, not least in supplying the Dublin region, was commented on by the IEA in its 2019 report. In response to a request from the Minister, the ESB in 2020 put forward suggestions as to how Moneypoint could serve to underpin security of supply beyond 2025 and become, in time, a renewable energy hub with links to offshore wind and renewable gas.

EirGrid, in its Generation Capacity Statement 2018–27 had highlighted the scale of expected decommissioning, with the potential loss of 2.4 GW of installed thermal capacity by the mid 2020s. This was generation capacity which would need to be replaced through the then new Capacity Remuneration Mechanism. In July 2021, when it was describing the electricity situation for each of the coming years as an emergency, EirGrid recommended that a way would have to be found to keep all existing units, which had been due to close, available to the system up to winter 2024/5. In August 2021 CRU noted the legal difficulties of securing the necessary environmental consents to enable such plants to continue in operation, as well as the financial issues which would have to be addressed if they were to be retained for that period. Nevertheless, the retention of thermal generation plant featured in the Programme of Actions put it in place by CRU and on which it published an Information Paper in September 2021.

(iii) Interconnectors

The availability of interconnection to other electricity markets reduces the risk to security of supply insofar as supply and demand conditions in the linked markets facilitate export/import as required. Interconnectors also provide desirable flexibility to electricity markets for the integration of high rates of renewables. Planned interconnection to Britain and France, in addition to the existing interconnector to Wales, will have a beneficial effect on security of supply in the second half of this decade. The existing North South interconnector, more accurately described as a tie-line, supports system security and adequacy in both jurisdictions. The Single Electricity Market was designed against the background of a planned new North South interconnector. While this is expected to become fully operational by 2026 according to the GCS 2022-2031, it was envisaged in GCS 2018-27 that it would be commissioned in 2023. Its absence as a result of planning delays and project reviews is relevant to the extent of the capacity shortfall.

(iv) Failure of New Plant to be Delivered

In the Single Electricity Market, capacity to generate from dispatchable, that is not intermittent renewable resources like wind, is procured by auction to meet forecast demand to the level of the approved reliability standard. These auctions under the Capacity Remuneration Mechanism began in 2018. Developers, who were awarded capacity in the T - 4 auction for plants to be operational in winter 2022/23, terminated the process in 2021 before delivery of an expected 513 MW. It was reported that this termination was attributed to the timelines of the required planning process and environmental consents and difficulties experienced with equipment vendors. In one case, the developer who reported such delays, terminated the development having been offered a three month extension when six months were sought. In any event, there is a clear implication that the price set at the first auction by which subsequently terminated capacity was awarded was considered to be low in the market and may have served to reduce the level of interest in later auctions on the part of developers.

By July 2021, in light of the termination of awarded capacity and the underperformance of demand side units procured at auction, the Department was expressing concern at the ability of the Capacity Market to deliver necessary generation. In November, while CRU was reporting a positive outlook for auctions under the CRM, EirGrid was communicating to CRU that it had no confidence that necessary low carbon generation would be delivered under the existing arrangements. By then the question of the operation of the CRM was being considered in the context of concern that a specific emergency might become a crisis of significant duration. The operation of the CRM is considered in more detail below.

(v) The Impact of Growing Demand for Electricity

Planning for generation capacity, both renewable and dispatchable, takes place in the context of expected levels of demand. Demand for electricity in Ireland, in terms of both peak and overall demand, has increased by 9% over the past five years. Significant increases in demand have been expected for some time, partly in response to overall population and economic growth but specifically as a result of investment in the development of large energy users, in particular data centres. It was well understood in 2017 that data centres being developed would each require from 10 MW to 140 MW of capacity via high-voltage connections, with power typically accounting for between 25% and 60% of their operating costs.

By 2017, there were 250 MVA of installed data centres, with a further 600 MVA with connection offers in place or in the connection process. It was reported that there were enquiries about connection of a further 1 GW for 2019 and later. It was widely understood that this growth in demand would present a challenge for electricity supply, particularly given the concentration of development in the Dublin region and constraints on the grid serving it.

EirGrid had estimated that 75% of foreseen growth in electricity demand would arise from data centres and that they could grow to account for 36% of total electricity demand by 2030. In the GCS published in October 2022 it was estimated that by 2031 28% of all electricity demand would come from data centres and other large energy users. While the rate at which

electricity demand would ramp up from individual data centres was uncertain, and it was expected that a significant proportion of enquiries about connection would likely not materialise as installed plant, growth in demand from data centres was central to the calculation of overall demand presented in each Generation Capacity Statement produced by EirGrid. Further increases in demand as a result of electrification of transport and heat in response to decarbonisation policies were also anticipated in the latter half of the decade.

The overall significance of data centres and policy regarding their development is discussed in a later section.

4.2 Was the Crisis of Capacity Expected?

The overall situation of the electricity market is the dynamic outworking of factors impacting on supply and demand. The electricity system is planned and operated with a view to securing balance between the two to an acceptable standard of reliability. This takes place against the backdrop of public policy regarding sustainability and decarbonisation. Investment in electricity generation and in the transmission and distribution networks is guided by the expectation of the level of demand to be met. Incentivising and funding this investment requires designing a financial framework that enables the right level and type of investment, while containing costs and securing economic competitiveness.

The principal public source for assessments of future supply and demand is the Generation Capacity Statement produced annually by EirGrid and SONI which, as noted earlier, presents forecasts for the Single Electricity Market, as well as for Ireland and Northern Ireland. The GCS is compiled in accordance with a methodology mandated by the Regulatory Authorities for the Single Electricity Market. The GCS seeks to inform market participants, regulatory authorities and policy makers of the generation capacity expected to be required for an adequate supply to meet forecast demand over a 10 year period. This required capacity is presented against the profile of existing and expected future capacity, including renewable and thermal generation, demand side flexibilities and interconnection. The ten year horizon

is designed to provide sufficient opportunity for market participants to plan, develop and deliver the necessary infrastructure to meet demand. This calculation of capacity surplus or deficit has regard to the reliability standard for each jurisdiction, the Loss of Load Expectation (LOLE), which is the expected number of hours per year that an electricity production system cannot meet demand. CRU sets the LOLE for Ireland at 8 hours and the Department for the Economy has set it at 4.9 hours for Northern Ireland. The GCS does not take account of mitigating measures, such as emergency generation capacity, which may be taken to address capacity deficits on a temporary basis.

Given the variables which impact on the level of demand actually experienced, including variations in winter temperature, the GCS presents a range of forecast demand levels, from low to high, which provide a sensitivity test to findings regarding capacity. A progressive tightening of the margin between supply and demand was flagged in the GCS process since 2016.

In GCS 2016 a surplus for all years was forecast in the event of demand at low or median levels, but a deficit would appear in 2023 in the event of high demand or without the availability of the East-West interconnector.

GCS 2017 forecast a deficit arising by 2021 under high demand conditions, but at median demand a balanced system would prevail until 2026.

GCS 2018 forecast significant deficits from 2024 at high demand levels and at median demand if there were low availability of generation capacity from existing plant.

GCS 2019 forecast deficits from 2026 as a result of the expected closure of Moneypoint at the end of 2025.

GCS 2020 forecast deficits from 2026 at median demands levels but poor availability of the aging generation fleet, as had been experienced in 2018 and 2019, could see deficits arising in 2025. Similarly, closure of other plants in addition to Moneypoint could produce an earlier deficit.

GCS 2021 forecast deficits for each of the next five winters as a result of the termination of projects awarded generation capacity under CRM auctions and the failure of a subsequent auction to clear sufficient capacity.

Prior to the emergence of the triggering events in 2020, the analysis of the electricity market presented by the successive GCS publications signalled an increasing level of risk regarding security of electricity supply. This reflected both the forecast increases in demand and the exit and low availability of dispatchable generation. The risk was forecast to turn into a security of supply problem in the period 2024 to 2026 without new generation capacity. It would not have been unreasonable to anticipate that new generation capacity would be delivered into the SEM as a result of investment in projects awarded capacity at CRM auctions. This expectation would have been reinforced by the level of interest in and the capacity awarded at early auctions under the CRM. The termination of the additional capacity which was expected to be delivered following success at auction, combined with unexpected difficulties with existing thermal plant and the anticipated increase in demand, gave rise to the security of supply crisis. In the way in which it emerged, this security of supply problem was not anticipated. Whether, and in what circumstances, it might have been reasonable to anticipate such difficulties and consequently to move to address them is considered below.

5. The Risk of a Capacity Shortfall

Previous sections outlined the emerging contours of the crisis in electricity supply. The crisis was triggered by events which were unpredictable, such as the impact of Covid restrictions, and unexpected, such as the forced outage of generation plants, including Power Plant B and Power Plant A. However, the crisis in the electricity market extends well beyond the impact of those triggering events. Structural features of the electricity market that contributed to the capacity shortfall - rising demand, ageing thermal plant operating in the context of increased renewables, the pending exit of generators because of emissions controls and decarbonisation policy - were known features of the electricity market as we entered into 2020.

The electricity market was also operating within ambitious policy goals to achieve a high level of generation from renewables, principally wind. The target of generating 40% of electricity from renewables by 2020 was succeeded by a target of 70% by 2030. As reaffirmed and developed in later statements of policy, the electricity system was expected to play a key role in the transition to a decarbonised economy, with the electrification of heat and transport representing a significant factor in the outlook for electricity demand by 2030.

In addition to supporting decarbonisation, the electricity system was also expected to play a major role in the digitalisation of the economy. The linked transitions of decarbonisation and digitalisation rested to a significant degree on the transition of the electricity system itself. This was not only a transition in terms of the sources of energy for generation, but also the profile of participants in the market. On the one hand, the system would require major investment in renewables, both onshore and offshore wind in particular, but also in new, efficient and flexible natural gas-fired generators with the capacity to adapt to renewable gas, to ensure security of supply even with very high levels of penetration of renewables. On the demand side, the digitalisation of the economy would see very substantial increases in demand from data centres in particular. In addition, there would be opportunities for investment in electricity storage and demand side units which would have greater flexibility as to when and how they consumed electricity, while smart meters would support more

efficient and sustainable electricity consumption. In order to accommodate the envisaged scale of increased generation and demand, the transmission and distribution systems would require extensive strengthening and upgrading, in particular due to the frequent mismatch between locations for generation and demand.

There were grounds for confidence about the ability of the electricity system to achieve the goals which were set for it by the policy system. In its 2019 review of Ireland, the International Energy Agency commented that the proven capacity of the system to accommodate high levels of variable generation at any given time was a remarkable achievement and proof of the substantial innovation and research capacity of the Irish economy. It went on to observe that a low carbon energy system based on the targeted level of renewables would ease concerns about security of supply arising from limited direct interconnection with European energy markets.

Further cause for optimism was the initiation of new arrangements for the Single Electricity Market from October 2018 and bilateral negotiations to ensure that the framework for the SEM would continue after Brexit. This in turn provided a clear framework for progressing the North South Interconnector whose construction had been envisaged at the initiation of the SEM in 2007. The new arrangements brought the electricity wholesale market into compliance with the 'target model' developed by the EU. Aspects of the SEM had been praised for avoiding problems encountered in the UK electricity market and there would have been an expectation that the transition to the new arrangements would be no less successful.[1] The apparent initial success of auctions under the new Capacity Remuneration Mechanism for the SEM gave grounds for confidence that investment in necessary generation capacity would be secured.

[1] M Grubb and D Newbury, UK Electricity Market Reform and the Energy Transition: Emerging Lessons, Energy Policy Research Group, Working Paper 1817, Cambridge 2018

Nevertheless, in addition to the specific known issues that marked the crisis that emerged in 2021 and were summarised earlier in this section, there were a number of looming risks to a successful transition for the electricity system.

The goal of a modern low-carbon electricity system meeting rapidly rising levels of demand in the digital economy requires extensive investment in generation, transmission and distribution, including new interconnectors and the bringing onshore of the intended volume of offshore wind capacity. Experience with all infrastructure projects in Ireland, including electricity investments, demonstrates the severe difficulties that can be encountered in securing planning consents. The IEA in 2019 remarked on the need that had arisen to extend the time for completion of projects supporting renewables under the REFIT programmes because of problems encountered in receiving planning consent and grid connection. Indeed, the principal recommendation from the IEA Review was the need to improve the efficiency of the planning consent regime for energy infrastructure to ensure that decisions are taken on time and with due regard to environmental and other effects.

A second risk related to the operation of wholesale electricity markets themselves. The unbundling of electricity markets and the introduction of competition was designed to put downward pressure on prices, in part by ensuring that only necessary levels of generation capacity were constructed, operated and remunerated. A review of the experience of electricity market liberalisation has observed that 'the design of markets to procure the required capacity has not been straightforward and design changes have been common'[2]. Adequate capacity has generally been procured, at least in periods of relatively slow load growth, with a tendency to encourage the development of demand response aggregators providing demand reduction services to the wholesale market. Caution about the prospects for success might also have been informed by the experience of the first auction under the British capacity market, when capacity was awarded for two large CCGT generators which subsequently withdrew having failed to secure investor funding.

[2] R Schmalensee, 'Strengths and weaknesses of traditional arrangements for electricity supply' in J-M Glachant, P L Joskow and M G Pollitt (ed) Handbook on Electricity Markets, Edward Elgar Publishing 2021, P 22

In light of the policy goal to achieve high levels of renewables in the system, potential investors in conventional generation plant would be faced with uncertain income from the energy market as a result of potentially low and variable levels of demand to supplement energy from renewables. On the other hand, higher levels of demand could expose them to penalties in respect of emissions or carbon. The impact of planned future interconnection and the need for renewal of European State Aid approval might have added to investor uncertainty about the operation of the market. It has been observed that the shift from a power system dominated by variable costs to one dominated by fixed costs, as the shift to renewables would represent, presents a challenge to electricity market design, to the extent that the SEM was considered to be moving into unknown territory at ever higher levels of renewables[3] In this context, a capacity mechanism might struggle to secure the desired level of investment in conventional generation in the tight timeframe for transition of the electricity system in Ireland.

A related consideration is the influence of the reliability standard underpinning the design of the electricity system. As noted earlier and as observed by EY Consultants in their Report for CRU, under the parameters set by the Regulator, Ireland operates to a higher level of accepted risk to continuity of supply - the Loss of Load Expectation (LOLE) - than most European countries and significantly higher than Northern Ireland. This would imply, other things being equal, an acceptance of a higher risk of threats to security of supply at a time when energy supply was expected to play a central role in achieving strategic economic and enterprise objectives.

The interplay of these factors was described in formal analysis of the outlook for the electricity market through Generation Capacity Statements published by the Transmission System Operators, EirGrid and SONI. Since 2016, these had been highlighting the trend towards tightening capacity margins of supply relative to demand. Indeed, as highlighted earlier, the GCS pointed to the likelihood of deficits in the system by the mid 2020s, with a risk that in

[3] M Lynch, G Longoria and J Curtis, Future market design options for electricity markets with high RES – E, Lessons from the Irish Single Electricity Market. ESRI Working Paper No 702, 2021

certain circumstances – spikes in demand due to cold weather or unexpectedly rapid ramping up of data centres, low wind availability or interruptions of interconnection – such a deficit could materialise earlier. The expectation, reflected in GCS forecasts, that this deficit would be averted by new capacity procured through auction in the SEM was dashed when projects that had been awarded capacity were terminated.

In 2018 the Irish electricity market was entering a period of intended rapid transition as the new SEM arrangements came into force. There were relatively short timelines to the exit on environmental grounds of a substantial share of the conventional generation fleet. This would need to be replaced through the new capacity mechanism so that the problem of intermittency of renewables would not threaten security of supply.

The electricity market is necessarily concerned with the estimation and mitigation of risk: that generation capacity may not be sufficient to meet demand to sustain economic and social life without interruption; that generation capacity may exceed requirements and impose excessive costs on consumers; that technical problems may lead to interruptions of supply; that the electricity system may not meet sustainability goals. The unbundling of the structure of electricity supply was designed to harness market power for analysis and innovation to secure efficient and effective outcomes.

However, having regard to the tight deadline for transition in the conventional generation sector, the ambitious target for increased generation from renewables, the expected rate of increase in demand primarily associated with data centres, the likely impact of planning delays and the challenges to market design outlined above, it is my opinion that the risk that the operation of the electricity market and the behaviour of market participants would not produce a smooth transition was underestimated. The unpredictable elements of Covid and the impact on energy markets of the invasion of Ukraine have little relevance to the underlying risks revealed by the crisis which has emerged.

I have seen nothing to suggest that any of the agencies or individuals concerned with the design and operation of the electricity market have been other than diligent, responsible and professional in the performance of their duties. It is rather the architecture of and framework for the electricity market which, in my opinion, gave rise to a systemic underestimation of the risk of an electricity market crisis.

My terms of reference require me to identify factors which contributed to any underestimation of the risk of capacity shortfall, including factors associated with respective roles and responsibilities, and to identify learning which may be relevant to strengthening policy, capacity, governance and operational effectiveness. I turn to those issues in the next section.

6. Strategic Issues in Securing Adequate Generation Capacity

As set out in previous sections, the crisis in security of electricity supply crisis is shaped by two significant features of the market structure: the operation of the capacity mechanism to secure investment in adequate generation to support continuity of supply given the ambition for high levels of intermittent renewable generation, and the increasing levels of demand for electricity from data centres in particular. The position regarding these two strategic issues is discussed below.

6.1 Capacity Markets

Prior to the restructuring of electricity markets to promote competition in the interest of increasing productivity and reducing costs, policymakers and the utilities responsible for generating and delivering electricity would set a reliability standard that ensured that electricity was always available except under extreme circumstances. This tended to require a high level of generation capacity which was included in the utility's asset base and paid for by customers and through public investment. As a result, it was generally considered that excess generation capacity was likely to be provided, with the cost borne by consumers.

With the unbundling of the supply side of electricity markets and relatively uniform tariffs for customers, competition between suppliers would tend to ensure that wholesale prices were set by reference to the variable cost of production, while fixed costs embedded in generation plant would not be remunerated. In order to ensure adequate generation capacity so-called 'capacity mechanisms' have been introduced into many electricity markets. Capacity mechanisms provide payments to the owners of generating assets to incentivise them to invest in and maintain the required generation capacity. Otherwise markets would require periods when very high prices were charged to provide sufficient incentive to invest in capacity. Payments under capacity mechanisms complement the revenue stream from the sale of energy actually supplied, as well as revenue that may be earned under system services contracts. By awarding capacity contracts only to the forecast level of required capacity and not to all generation, competitive capacity auctions tend to secure capacity at a significantly lower cost than administratively determined capacity payments. This was the experience at the initiation of the CRM in Ireland in 2017.

Designing markets which provide sufficient incentives to secure adequate capacity at least cost to consumers is challenging. This is particularly the case given the goal of increasing generation from variable energy resources. While mitigated by developing technology for electricity storage, the variability of renewables such as wind makes dispatchable capacity, that can operate when the wind does not blow, much more valuable. However, the total amount of electricity required to be supplied to the market by dispatchable plant will be highly variable in line with variability of supply from renewables. Generation capacity delivered through the CRM is crucial to ensure security of supply.

This is the background to the design of the Capacity Remuneration Mechanism in the Single Electricity Market which seeks to secure sufficient dispatchable generation and storage to meet forecast levels of demand to a prescribed standard of reliability. Prior to 2018, a Capacity Payment Mechanism operated in the Single Electricity Market under which administratively determined capacity payments were made to all generators whether or not they were available when required.

It has been brought to my attention that at least one market participant raised what they regarded as design flaws in the intended CRM prior to its introduction on the basis that it could tend to favour lowest cost providers and so inhibit new entry and competition, and lower cost technologies rather than flexible generation plant more aligned with operating requirements in markets with high levels of renewables. However, the CRM was introduced with the relevant European approval.

While levels of interest in early auctions under the CRM were encouraging, the termination of capacity due for delivery for 2022/3 and low levels of participation in subsequent auctions raised doubts about the effectiveness of the mechanism. In August 2021 CRU advised the Minister that, in the light of this disappointing experience, the Single Electricity Market Committee would keep under constant review the various factors and auction parameters that can influence a successful outcome including, for example, the timeframe for delivery, the potential signals to get a balanced portfolio, delivery incentives, price caps, de-rating factors and potential locational signals. The CRU indicated that it would itself introduce

formal, earlier and more frequent updates on project delivery in Ireland to identify any timeline slippage on projects. It pointed out that certain parameters within which CRM auctions are held are set by the terms of the European State Aid approval and so cannot be varied, but non-CRM actions, such as new oversight arrangements, could be taken to facilitate the timely delivery of new generation.

A review of the auction process formed one of the elements of the Programme of Actions initiated by CRU with the support of the Department and EirGrid in response to the security of supply crisis. In November 2021 CRU advised the Department that an external review of the performance of the CRM was being commissioned. In this context, EirGrid proposed to CRU that the future of the CRM should be viewed in the context of the required combination of payment streams which would complement each other and, in combination, deliver the necessary generation portfolio, including capital intensive closed cycle generation (CCGT) and less capital intensive open cycle generation (OCGT).

EirGrid suggested that the current CRM focuses on the lowest capital cost plant, rather than the generation mix required to enable the transition to a very high penetration of renewables. EirGrid proposed a number of areas for consideration, including shifting the emphasis from penalising generation which is not available at times of scarcity to rewarding plant which provides the required service, and targeting enough capacity at auction to allow for known risks of non-delivery.

I was supplied by EirGrid with a copy of a July 2022 Report of a Review of the Generation Capacity Statement and the Capacity Market Processes which they had commissioned from BDO Consultants. This Report suggested that the capacity market has inherent flaws that resulted in insufficient capacity being procured at auctions. This, it was suggested, reflects the fact that the Regulatory Authorities (RAs) consistently approved a lower volume of capacity than recommended by the Transmission System Operators (EirGrid and SONI) without a transparent and evidence-based justification to support the lower volume. The Report also suggested that the process used to supervise the implementation of new awarded capacity was not fit for purpose, such as the fact that the RAs did not verify progress reports submitted about the implementation of projects.

The Report also suggested that the capacity reliability standard (LOLE) mandated by CRU is not appropriate for the electricity system required in Ireland and, given that the LOLE is a key parameter, the capacity market is therefore not delivering what is required for electricity system security. In addition to the overall volume of generation capacity required, the Report suggested that the CRM does not target the appropriate mix of technology, having regard to higher levels of renewables and increasing emissions standards.

In their Report on the Performance of the SEM Capacity Remuneration Mechanism commissioned by CRU in January 2022, EY Consultants presented their review of how the CRM could be strengthened to deliver on its core objective of ensuring security of supply. Its report focused on four key questions: the volume of capacity procured in CRM auctions; the level of participation in CRM auctions; the delivery of new build capacity; and the value of capacity procured. As noted above, this review was undertaken in the context of the Programme of Actions being led by CRU in response to the projection of a potential capacity shortfall of 2 GW by 2030.

EY noted that since the start of the CRM 2568 MW of capacity, both new and existing, has been awarded, of which 643 MW was terminated, mainly new gas generation. Their Report attached particular significance to the challenge of securing necessary planning and environmental consents within the required timelines. A T -4 auction typically provides 3.5 years for delivery, which is likely to be insufficient to enable new build facilities without planning approval to be completed. As a result, they attributed the problem of termination of projects largely to delays in planning consents outside the developers' control. They also pointed to two aspects of uncertainty which, in addition to planning delays, might affect the level of interest from potential investors. They suggested that the GCS did not give sufficiently clear signals to the market about the scale of new capacity required, noting that estimates of peak demand were reduced in GCS 2019 and 2020 due to amended estimates of the ramp out rate of data centres. They also suggested that uncertainty about the parameters of the market following the process of renewal of European State Aid beyond 2025 might be a factor for some investors. They suggested that this may be also be a factor in the preference of investors for low capital OCGT generators, as well as the likelihood that the expected low load

factors in a decarbonised energy system might make more capital intensive CCGT generators less attractive, despite the additional revenue they would earn in the wholesale market.

EY noted that, while the existing reliability standard, the LOLE, has been met to date it leaves little room for error around the volume of generation capacity to be procured and they suggested that it be reviewed. They argued that the process by which the target volume to be procured at auction is opaque and does not clearly signal to developers the growing need for capacity. They suggested that there was a need for a degree of external scrutiny of decisions regarding the volume to be procured. Given the difficulties with timelines to delivery, EY suggested that the auction process should allow realistic timelines to secure necessary consents. While highlighting the value of tighter monitoring of delivery of projects awarded capacity, EY pointed out that restricting entry to auctions to those with necessary consents, or a strong prospect of securing them, would increase the reliability of delivery. However they noted that this would give rise to costs for developers without assurance of their recovery. They also suggested that investment in the transmission system would increase the range of locations where generation plant could be readily located and so increase potential entries to auctions.

EY noted the importance of considering the operation of the CRM in the context of other financial incentives in the electricity market, such as through reliability options and the balancing market. They noted that it is the total revenue available from the market that would influence investment in generation capacity and in demand side units, with the latter offering a cost-effective means of addressing risks to security of supply.

Following receipt of the EY Report, the SEMC initiated a public consultation in August 2022 on many of the issues and proposals contained in the Report. The SEMC reported that it had already begun progressing some of the EY recommendations, including enhanced monitoring for new capacity, had initiated consultation on some other specific measures, and had initiated studies which would feed into a re-evaluation of the reliability standard to which the market operates. The closing date for submissions was 21 October and these are being considered by the SEMC.

It is through the operation of the CRM that CRU plan to procure 2 GW of enduring generation capacity by 2030 in the form of flexible gas-fired generators. This year, the T -3 auction under the CRM held in January secured a total of 1471 MW of capacity including new gas-fired generation and battery storage facilities to come online in October 2024 on an All-Island basis. The T -4 auction held in March procured 381 MW of new capacity in Ireland, including 104 MW being converted to gas, but this did not meet the volume requirements set for the auction.

It is clear that the CRM has failed to deliver the required generation capacity thus far. It is the absence of that capacity which has given rise to the need to secure temporary emergency generation capacity. In view of the detailed analysis and consultation on the operation of the CRM which is underway, and the technical character of the issues involved in determining the appropriate features of the auction process, I consider that it is beyond the scope of my review to determine whether particular aspects of the market design gave rise to these difficulties. It will, however, be critically important for the achievement of future electricity market targets that the capacity mechanism and the other elements of market structure are robust in securing adequate investment, including from new entrants in support of competition, and new technologies in support of efficient supply.

6.2 Data Centres and the Electricity Market

As noted in the previous section, growth in demand from data centres has been the principal factor in increased demand over recent years and will continue to account for much of the significant increase in demand forecast to 2031. As noted earlier, this impact on demand has been well understood and has shaped the outlook for the electricity market over recent years. For this reason, the role of data centres merits some consideration.

While Ireland as a location for data centre investment has not been actively promoted for some years by the development agencies, there has been a remarkable focus on Ireland, and the Dublin region in particular for such investment. Indeed, Dublin by 2017 had become home to one of the largest clusters of data centres in Europe. This was seen to reflect the attraction of Ireland's temperate 'free air cooling' climate, which potentially gives rise to very significant reductions in running costs, together with advanced telecommunications infrastructure and

a robust energy system. This investment had become a key part of the enterprise landscape. The location here of their cloud computing and data centre activities by leading IT and technology firms was seen to underline Ireland's status as a global leader in the digital sector.

The importance of competitively priced, world-class infrastructure (including energy generation, supply, transmission, distribution and interconnection) and related services were seen as critical to support economic growth and enterprise development, including data centre projects in particular. The scale of that activity was already understood by 2017 to be creating challenges for the electricity sector, in part as a result of congestion in the Dublin region. While the rest of the country was attractive in terms of ease of connection to the electricity grid, it was at a disadvantage for data centre projects in terms of the availability of fibre broadband. While digital companies typically sought to use energy from renewable sources, there was a mismatch between the locations for generation and for demand, with transmission rather than generation constraints affecting supply. Meanwhile, EirGrid reported that it had no capacity in the Dublin region to connect projects beyond those already committed without significant network upgrades, which typically take 6 to 7 years to bring online

Despise these challenges, and the significant costs that all customers would face as a result of increased investment in the electricity system to meet significant rates of increase in demand, investment in data centres on this scale was seen as essential to Ireland's ambition to play a leading role in the digital transformation of the economy, in terms of profile and reputation as a digital hub, with substantial ripple effects on the scale of overseas investment in the economy. For that reason, in October 2017 the Government adapted a Policy Framework on data centres which envisaged the adoption of a National Policy Statement on the strategic importance of data centres, a recalibration of the renewable electricity policy development framework, appropriate amendments to legislation in respect of planning, and the identification of specific sites and regions throughout the country that would be suitable for large-scale data centre projects in terms of their proximity to necessary energy and other appropriate infrastructure.

In June 2018 the Government published the Statement on the Role of Data Centres in Ireland's Enterprise Strategy envisaged in the Policy Framework. This highlighted the importance of data centres to the digital economy and of their presence here as highlighting Ireland as a location of choice for sectors and activities that are increasingly reliant on digital capabilities including manufacturing, financial services, animation, retail and global business services. The Statement noted however that data centres pose particular challenges to the future planning and operation of a sustainable power system. The Statement noted that total demand for electricity from data centres in the Dublin area could treble within 10 years. In response, the Government expressed its intention to take a plan-led approach to develop measures to promote regional options for data centre investment, minimising the need for additional grid infrastructure. The Statement committed that a consistent and supportive whole of government approach would be brought to the realisation of the transmission and distribution assets required to support the level of data centre ambition. There would also be measures to support very significant increases in renewable generation. This would include a role for Corporate Power Purchase Agreements (CPPAs) under which businesses purchase electricity directly from energy generators, in particular renewables. The Government announced its intention to amend planning legislation so that projects of a significant scale could be regarded as strategic infrastructure development, as well as reviewing judicial review timelines, so as to provide greater certainty to investing companies. This plan-led approach would, it was contended, allow Ireland to optimise the benefits of strategically important investments in data centres.

In its 2019 Review of Ireland, the International Energy Agency noted that it was the strategy of the Government to establish Ireland as a preferred location for the global digital and data hosting industry, and the implications for increasing electricity demand, as had been estimated by EirGrid. Noting the constraints that connectivity to fibre networks and telecommunications create on dispersal of data centres to the regions, IEA highlighted the pressure of their installation in Dublin on the resilience of the electricity system. As a result, IEA observed that the prospect of data centre growth would require regular assessments of the power networks to identify required improvements of the existing infrastructure in the short, medium and long-term to meet growing demand.

With the emergence of the crisis in capacity, EirGrid recommended to CRU and advised the Department in March 2021 that a new policy should be developed on data centres, addressing their future role and location. Consideration of this new approach began in a changed context since 2018 marked by wider industry concern at the risks to security of supply, appreciation of the need for industry investment and performance to be aligned with energy efficiency and decarbonisation goals, progress in the development of CPPAs, and a growing emphasis in electricity markets on demand flexibility as a critical ingredient in system resilience and efficiency. What had not changed was the view that data centres remain a core enabler of a technology-rich, innovative economy whose presence, in turn, places Ireland on the global map as the location of choice for a broad range of sectors and activities.

Following a process of consultation, CRU issued a Direction in November 2021 to System Operators relating to data centre grid connection processing. This was based on the judgement that data centres required to be recognised as a particular category of large energy user because their growing demand was contributing disproportionately to the problem of security of supply. It directed that data centre connection applications should in future be assessed having regard to a number of criteria: their location vis-a-vis a constrained system; their ability to bring on-site dispatchable generation and/or storage equal to or greater than their demand; their capacity to contribute flexibility to the system by reducing consumption when requested through the use of on-site generation or storage; and their ability to reduce consumption in times of system constraints. While electricity demand from data centres already connected, or with firm offers of connection, would continue to increase significantly as reflected in GCS 2022-31, this framework was seen to provide a measure of protection from overwhelming demand growth, while sending clear signals to the industry to inform their locational and energy strategies.

The policy position was reinforced by the publication in July 2022 of a new Government Statement on the Role of Data Centres in Ireland's Enterprise Strategy. This renewed Government support for data centres as enablers of the twin transitions of digitalisation and decarbonisation of the Irish economy and society. They were said to provide the foundation for almost all online aspects of social and work life, including public service delivery. The Statement emphasised, however, that there was only limited scope for further data centre

development due to capacity constraints created by the need for enhanced infrastructure. The Statement set out the Government's commitment to prioritising future data centre developments that deliver strong economic benefits, sustainable energy plans, and a willingness to promote Ireland's national decarbonisation objectives. These priorities were reflected in a set of national principles set out in the Statement to guide decisions on future data centre development, including a preference for developments that make efficient use of the electricity grid, that can demonstrate the additionality of their renewable energy use in Ireland, that co- locate a renewable generation facility or advanced storage, whether by a CPPA or otherwise, and that can demonstrate a clear pathway to decarbonise and ultimately provide net zero data services.

As a result of this new approach to data centre connections to the grid, EirGrid in the GCS 2022–31 observed that under the new arrangements, data centres represent 'net-zero demand' for forecasting purposes. However, existing data centres and those with firm connection offers will continue to drive demand upwards, with an increase of more than 50% in electricity demand by 2031 on a median demand forecast.

7. Institutional Factors Relating to Estimation of Risk

As reviewed in the previous section, there was a proper appreciation prior to 2020 that risks to generation adequacy existed as a result of the exit of older, conventional generating plant, the need to secure their replacement on time with cost–effective gas-fired generation to underpin continuity of electricity supply increasingly generated from renewables, and significant increases in demand in particular from data centres. Two systemic risks to a successful transition of the electricity system that may not have been so prominent were delays in project delivery due to planning consents, and the risk that the capacity mechanism would not secure adequate generation on time.

7.1 Ownership of Planning Risk

As noted in the previous section, the International Energy Agency in 2019 identified planning issues as a critical factor for achievement of policy goals for the electricity system. This problem was confirmed when developers of generation projects which had been awarded capacity at auction terminated their projects and reported to CRU that planning issues had been a significant factor in their decision. At the onset of the electricity crisis in 2021, the importance of planning and environmental concerns for security of supply was prominent in the engagement between the relevant authorities, not least in the attempt to install on time temporary emergency generation. Generation capacity, including temporary emergency generation capacity, was brought within the scope of the streamlined planning process under amending legislation. However, as was observed by the Department, assumptions about how and to what degree environmental consents could be extended or varied to allow an extension to the operation of plant which was due to close were not well-founded. CRU reported to the Department that engagement with the relevant authorities on the Programme of Actions initiated in response to the crisis had deepened their insight into the operation of planning and environmental controls.

The IEA had recommended in 2019 that effective cross-departmental and cross-agency cooperation and collaboration on agreed policy objectives and early engagement by developers with affected communities and other stakeholders could reduce delays in building critical infrastructure. However, the significance of the risk of delays to projects was not reflected in a robust engagement with the planning and environmental consenting system prior to the crisis.

Planning issues were prominent in the coordinated response to the emerging crisis in 2021. CRU and EirGrid recommended to the Department that a statement of government policy on the key importance of adequate conventional generation to underpin security of supply in the transition to high levels of renewables would be an important contributor to increasing the prospects of successful delivery of new plant. Such a clear statement of the need for new flexible generation was seen to be important in signalling to planning authorities that such projects should be considered in the strategic national context. There were other reasons to propose such a statement, as discussed below. In the event, the Government Statement on Security of Supply published in November 2021 contained the recommended message. This was a similar approach to the message to the planning system supporting data centre developments contained in the Government Statement on the Role of Data Centres in Enterprise Policy issued in 2018.

The operation of planning controls is also relevant to the development of the transmission system. EirGrid produced a roadmap entitled 'Shaping Our Electricity Future' in 2021 following extensive community and stakeholder consultation. This highlighted a number of pointers to securing public acceptance of necessary infrastructure development, including extensive engagement and gain-sharing. It also highlighted the benefits of a plan-led approach to developing infrastructure, such as had been envisaged for development of new data centres in the Government Statement of 2018, in addressing legitimate concerns and engaging public support. EirGrid reported that it had changed its whole approach to the planning and development of key infrastructure projects in the light of this insight and that the experience of operation of these changes had been positive.

Overall, it would appear that the planning risks associated with electricity infrastructure were seen as part of the general challenge of developing a system which would balance communal need for new infrastructure with the requirements of the planning code, including compliance with European and national legislation and the associated rights to object and challenge development proposals. Compliance with environmental obligations was seen as the responsibility of individual project developers. In that sense, there was not a single owner of the planning risk to achieving on time the electricity system transition.

7.2 Delivery in the Single Electricity Market

The risk that new generation capacity would not be delivered on time to replace exiting older plant, and so underpin security of supply to meet growing demand, was also a function of the risk that the institutions and policies of the Single Electricity Market would not deliver the required capacity. At a national level, the design and operation of the market were matters for the Department, for CRU and for EirGrid, who between them created and managed the framework within which market participants operated. Their respective roles in relation to the management of that risk are considered below.

7.2.1 The Department

The Department has a wide responsibility in respect of energy matters. It functions in the context of an extensive body of European law with regard to energy policy and gas and electricity markets in particular. Its responsibility for legislation and policy in energy matters is therefore highly constrained by the European context. Indeed, in 2020 in its briefing of the incoming Minister, it highlighted the importance for its legislation and policy work of compliance with European legislation across a wide range of its functions. This had been the context for some time: the EU Renewable Energy Directive had set a legally binding target of meeting 16% of energy needs from renewables by 2020, which was transposed in an Irish context into meeting 40% of electricity demand from renewables by 2020. It was not solely a matter of compliance with European demands, however: the Programme for Government in 2016 had committed to decreasing dependence on foreign fossil fuels through the continued

development of indigenous renewable, energy. The Climate Action Plan (CAP) adopted in 2019 targeted 70% of renewable electricity by 2030, as well as ending coal burning in Moneypoint by 2025. The CAP also contained a long-term strategy for reducing greenhouse gas emissions by 2050, in line with European policy. The CAP adopted in 2021, with associated investment priorities contained in the National Development Plan, provided for an increase in the target for renewable electricity to 80% by 2030, including up to 5GW of offshore wind energy.

The priority of the Department was to contribute to the development of climate policy within a whole-of-government framework and then to develop national energy policy in the context of climate goals, including compliance with the European Clean Energy Package and the policy objectives of the European Green Deal. Priorities identified in 2020 included optimising the opportunities presented by onshore and offshore renewable energy potential, as well as advancing policies to support energy efficiency across the economy.

The Department was clear in its briefing in 2020 that the phasing out of generation from peat and coal would lead to an increase in reliance on natural gas in the near term for the operational stability of electricity supply. This contributed to the Department's identification of security of supply of natural gas as a key issue and its intention to carry out a review of this issue, focusing on the period to 2030 in the context of ensuring a sustainable pathway to 2050. This was to include a full technical analysis of challenges to security of supply followed by public consultation. The envisaged analysis was commissioned from CEPA Consultants and published as part of a public consultation initiated by the Department in September 2022.

The Department, not unreasonably, saw responsibility for securing the necessary investment in conventional generation capacity as the statutory responsibility of CRU, with their performance of that role informed and supported by the statutory responsibility of EirGrid to forecast demand and the consequent necessary generation capacity, while delivering an appropriate and efficient transmission and distribution system. The Department secured

confirmation that the Single Electricity Market would continue to operate after Brexit. The market structure of the SEM had received state aid approval from the European Commission and was accepted to be in conformity with European electricity market regulations. This included specific approval for a capacity mechanism within the SEM, which was required because of their perceived potential to distort competition in the European electricity market. The regulatory powers of CRU and its Northern Ireland counterpart to operate the SEM jointly through a single mechanism, on the one hand, and the technical capacity and market insights of EirGrid on the other, constituted a rational market framework within the parameters set out in legislation.

The Department exercised active governance responsibilities in respect of both CRU and EirGrid. It engaged regularly with both organisations, received reports on activities and commented on draft statements of strategy and work plans. In doing so, the Department was conscious of the fact that CRU was legally independent in the performance of its functions and was entirely accountable to the relevant Oireachtas Committee for such performance. Nevertheless the Minister was briefed regularly on these matters and advised that the Department was in regular contact with CRU and provided feedback regularly and informally, but on the basis that CRU was free to take on board or ignore such comments as it chose. It would appear that the Department was broadly happy with the quality of this engagement.

When intimations of a crisis in electricity capacity were received by the Department in early 2021 it responded appropriately and proactively. The Minister and senior officials met promptly and regularly with CRU and EirGrid, both separately and together. The situation was reported on regularly to the relevant Cabinet Committee and to the Government. The Minister sought frequent reporting on the management of the crisis and detailed reports from both CRU and EirGrid on the reasons for the crisis and the steps which would be required in the short, medium and long-term to address the underlying issues. The Department engaged with other departments and agencies on planning and consenting matters as they arose and coordinated the development of relevant statements of government policy. While the Department participated in a CRU-led governance structure to ensure delivery of the various

work streams of the Programme of Actions approved in 2021, the Department also sought and received regular accounts of progress from CRU. Following the invasion of Ukraine by Russia and the strategic challenge to energy supply, the Department put in place a National Energy Security Framework and has led at senior level a cross-agency Energy Supply Emergency Group to oversee all national actions required to secure energy supplies, including measures to accelerate the growth in renewable electricity from both onshore and offshore resources.

There was in effect a formal division of labour in which the Department was responsible for national policy and legislation, including engagement in the development of European energy policy, while CRU regulated the market and EirGrid operated the regulated transmission system and planned the development of the national grid. With an increasing European and national focus on climate action and decarbonisation, it would not have been surprising if it were perceived that the Department's primary concern was on the achievement of very high levels of renewable electricity. For example the Climate Action Plan 2021 increased the target for generation from renewables by 2030 up to 80%, an increase which it was recognised would have significant implications for operation of the electricity system, including the grid. While it is clear that the Department was fully aware and supportive of the importance of expanding conventional generation capacity, with an associated increased dependence on natural gas pending the commercial availability of hydrogen and other renewable gas, this may not have been fully appreciated in the market. Such at least was the apparent conclusion of CRU and EirGrid in recommending in 2021 that part of the response to the crisis should be a clear statement of government policy expressing support for the development of 2GW of appropriate conventional capacity by 2030. As noted above, this was done in part to send a clear signal to planning authorities about the importance of this infrastructure, but it was also to send a clear signal to the market that it was national policy to support this expanded conventional capacity, appropriately configured, as well as highly ambitious targets for renewables. It was believed that such a statement would give confidence to investors in developing projects for submission to capacity auctions. The relevant commitment was contained in the Government Statement published in November 2021.

7.2.3 Commission for Regulation of Utilities

The statutory responsibilities of CRU and EirGrid were set out in an earlier section. As already noted, CRU operates the electricity market on an All-Island basis jointly with the Utility Regulator of Northern Ireland through the Single Electricity Market Committee. The design of the market reflects the terms of the approval received from the European Commission within the context of European electricity market policy. These parameters continue in the post-Brexit environment. While the rules governing the operation of the market are detailed, complex and transparent there is inevitably a degree of judgement required to implement that framework. In particular, the reliability standard by reference to which adequate capacity is calculated embodies an expression of acceptable risk regarding security of supply. As noted, the reliability standard for Ireland is relatively low. The decision as to how much generation capacity should be procured in auctions is also informed by the forecasts prepared by the Transmission System Operators. However the determination must be made by the SEMC as to how much capacity is to be sought in individual auctions. This is a judgement about how best to protect the interests of consumers of electricity when balancing the obligation to maintain security of supply with minimising the cost to consumers. A level of capacity which is greater than necessary entails significant cost and as capacity increases, costs may rise exponentially.

A second issue on which judgement must be exercised is the design of the auction process as regards qualification to enter. Widening the pool of potential participants at auction to encourage interest and competition entails a trade-off with increasing the assurance of delivery of the capacity actually awarded by focusing on those with appropriate sites and permissions. This continues to be a live issue in the design of the auction process as noted in the EY Report commissioned by CRU discussed in the previous section.

In more general terms, the electricity market has different components: capacity markets, system services and other ancillary services to ensure that there is an appropriate financial incentive to secure the desired outcome. This is not only about adequate generation from both renewables and conventional plant, but also electricity storage and demand side flexibility which enable the challenge of intermittency to be met on a cost-effective basis by reducing the extent to which peak demand might drive undesirably high and costly volumes of generation capacity. Avoiding unnecessary cost is a substantial issue given that the industrial development agencies regularly highlight the importance of energy costs to the overall competitiveness of the Irish economy. Furthermore, extensive engagement by EirGrid with the public and with industry in preparing its Roadmap, Shaping our Electricity Future, revealed that there is no appetite for the cost of electricity to rise because of the transition to a low-carbon electricity system.

As with any regulated economic activity, the outcome typically involves an iterative process of regulator and regulated entities responding to each other's signals and behaviour. Over time, adjustments can be made through learning in the market which tends to correct imbalances which may occur in volumes or price in the short term. The greater the insight of regulators into the objectives and priorities of market participants, the more likely they are to frame appropriate incentives. Equally, the more coherent and transparent the intentions and priorities of the regulator, the more likely market participants are to align their behaviour with the intended evolution of the market. In the transition of the Irish electricity market described above, there has been limited time for the regulatory process to develop a robust approach to securing the desired outcomes. Given the general experience of capacity mechanisms reviewed in the previous section, it was not surprising that there would be difficulties with early capacity auctions.

Apart from the issue of limited time, a further significant factor is that the Single Electricity Market is governed by a joint body which necessarily sits at one remove from the legislative and accountability frameworks within which the two Regulatory Authorities separately operate. This gives rise to a further element of judgement required to be exercised by the regulator in framing procedures and rules which reflect the integrated nature of the market in the context of the particular circumstances in each jurisdiction and the practical consequences of the absence of the intended North South interconnector. This includes the need to determine whether issues materially affect or are likely materially to affect the SEM and so become an SEM matter, rather than a matter for the individual Regulatory Authorities. There is a structural challenge then in developing clear signals about the evolution of the market in the longer term.

7.2.4 EirGrid

The roles and responsibilities of the Transmission System Operators (TSO), EirGrid and SONI, in the SEM are, at least in regulatory terms, somewhat more straightforward. Theirs is the responsibility to plan and develop the transmission system so that it enables necessary generation plant to connect to the grid and to deliver bulk electricity for distribution to final customers. In discharging these responsibilities, the TSOs engage directly with key market participants and so develop insight into emerging trends and requirements. This market insight is channelled into the design of the electricity market through the annual publication of the Generation Capacity Statements reviewed earlier. These are produced through a methodology approved by the regulator in line with European standards. This methodology is currently under review to reflect recent developments at European level. Over recent years, the GCS has included further sensitivity analysis to give greater insight into the likely impact of different possible trajectories within the market. The TSOs are themselves subject to regulation by the SEMC. Their responsibilities for planning, operating and reinforcing the grid require a long-term approach to the provision of key infrastructure whose construction is often sensitive and controversial.

As noted earlier, issues about the GCS in terms of the clarity of the signal it has provided regarding expected demand have been raised. Equally, questions about why the volume of capacity to be procured at auction has been less than identified as necessary through the GCS process have also been raised. Differences of emphasis have been evident in the public commentary about the development of the electricity capacity crisis as between CRU and EirGrid.

It is not surprising that there should be some tension between a regulator and a regulated entity; indeed, the absence of such differences might be a cause for some concern. In the electricity context there may be a structural basis for a difference of approach with regard to capacity issues. It has been pointed out that a system operator's analysis of necessary capacity may reflect "a bias towards over-procurement in that the system operator stands accountable if 'the lights go out' but does not pay for the capacity"[4] Regulators, on the other hand, may be more directly implicated in the level of charges faced by customers, including the cost of excess capacity.

Apart from structural issues in the market and the limited time to develop learning about the operation of the new market mechanisms after 2018, there was potentially a resource constraint that impacted on the ability of agencies to deliver optimal outcomes. Staffing issues in CRU were highlighted in the Report of a Review of its operation by the OECD which concluded that it should have more flexibility over its staffing arrangements. A strengthening of the capacity of state agencies responsible for the delivery of ambitious targets for climate action was highlighted in the Programme for Government. CRU reported to the Department in the context of its Resource Plan 2022–24 that market design work had been frequently delayed by a lack of staff. Work on forwards markets and liquidity demand by market participants had been delayed due to lack of staff, it was stated, as was the delivery of new

[4] D Newbery, 'Strengths and weaknesses of the British market model' in J-M Glachant, P L Joskow and M G Pollitt, (Ed) op cit, P 165.

competitive arrangements for electricity system services necessary to accommodate more renewable energy to meet targets for 2030. In the context of approval of 74 additional posts CRU explained they were needed to implement fully the security of supply Programme of Actions, delivering a secure energy transition by 2030, developing a new regulatory framework for offshore wind, hydrogen and district heating programmes, as well as fully resourcing the development of an agile investment framework that monitored and revised market incentives.

For both CRU and EirGrid, the attraction and retention of personnel with the appropriate level of expertise is a challenge in the context of demand for such personnel across the energy sector, both nationally and internationally.

7.2.5 Summary

In summary, the architecture of the electricity system in line with European policy created a framework in which the Department was concerned with overall policy on climate action and compliance with evolving European requirements, while focusing its particular concern on the risk to security of natural gas supply given its critical role in both the gas and electricity markets. CRU as the regulator was responsible for operating the mechanisms of the SEM to secure investment in the system to enable supply to meet demand on a rolling basis, while EirGrid, as the TSO, was responsible for delivering an appropriate National Grid and informing regulatory decisions through its analysis and forecasting of supply and demand over a ten year horizon. Each body operated to its own mandate in the context that a rapid energy transition was mandated by policy and would require the orderly exit of old and high carbon plant and the timely entry of new, flexible conventional generation to underpin a highly ambitious target of generation from renewables.

8. Conclusions and Recommendations

A commonsense view of energy security of supply is expressed succinctly in the CRU Strategic Plan 2022–24: 'the lights stay on and gas continues to flow'. For this to be assured for electricity there needs to be security of long-term supply of primary energy, electricity generation capacity needs to be sufficient to meet demand to an agreed-upon security standard, and the system needs to be reliable and able to react to unforeseen circumstances without recourse to uncontrolled blackouts. Apart from the impact of interruptions to daily life when electricity supply is interrupted, concerns about security of supply damage a country's reputation and impact on competitiveness, especially when many sectors of the economy depend on continuous energy supply.

Security of primary energy for electricity purposes was served in the past by the variety of sources for generation. A number of these are no longer acceptable or will soon cease to be acceptable on environmental grounds: oil, peat and coal. Increasing levels of generation from renewables, principally wind and solar, enhance security of supply but both give rise to issues of intermittency. Reliance on gas-fired generation to supplement high levels of renewables when the wind does not blow and the decision not to license further natural gas exploration, have given rise to concerns about security of natural gas supplies, pending the development of hydrogen and other renewable gas sources on a commercial basis. As noted earlier, this is an issue which the Department has identified as a strategic priority and is addressing through expert technical analysis on which a public consultation was launched.

The question of system reliability is primarily a question of the capacity of the grid to transmit and distribute electricity from generation to consumers. This requires planning and delivery of new infrastructure and the adaptation and reinforcement of existing infrastructure in response to changing patterns of generation and demand. Congestion in the Dublin region and the mismatch between the locations of renewable generation and typical high load demand locations pose challenges to reliability. In 'Shaping Our Electricity Future', EirGrid identified an extensive programme of necessary reinforcement of the grid especially for Dublin and the Mid-East, together with new transformer capacity at transmission interface

stations to accommodate growing demand on the distribution system in the Dublin area. Investment is also required to accommodate large wind and solar generators in the Midlands and offshore wind generation along the east coast to the south of Dublin. In total EirGrid have identified about 350 transmission reinforcements required to support at least 70% renewables by 2030 and more will be required to meet the revised 80% target. On the other hand, the electricity system has been adapted to facilitate very high levels of renewable generation which is an important marker of system reliability for a low-carbon future.

It is the issue of generation capacity which is the focus of the crisis in electricity security of supply which has arisen over the past 18 months. To summarise the issues discussed in earlier sections of this report, the Irish electricity system was entering a challenging transition when the current arrangements for the Single Electricity Market became operative in 2018. The outlook was for sustained and significant increases in demand for electricity as a result of economic growth, the expected electrification of sectors such as heat and transport, but particularly demand from large energy users, principally data centres. Supply to meet this demand was to be generated by a system which was advancing towards high target levels of generation from renewables by 2030, while the conventional generation fleet would be marked by increasing unreliability and then exit of a significant percentage of capacity provided by older and more polluting generators. Their exit required to be replaced by the timely introduction of new, more flexible gas-fired generators which would ensure continuity of supply at times when the wind did not blow. A crucial third aspect of the transition was the operation of the All-Island Single Electricity Market, in particular the new capacity mechanism, which was designed to secure investment at competitive rates in needed conventional generation plant through an auction process, whose parameters had received European State Aid approval and reflected the European electricity framework. Capacity was to be procured in good time for new generation plant to be operational when required, typically four years after auction.

Electricity markets are operated on the basis of managing risk: that demand might outstrip supply, that generation capacity might be greater than required at a higher cost to consumers, that technical issues may interrupt supply. These risks are mitigated: through standard and formalised procedures to calculate and forecast supply and demand, through the active management of the system to balance supply and demand, including importing electricity from interconnectors, and through well-developed protocols to bring about reduced demand on a planned basis in an emergency to minimise disruption. Electricity markets are not designed to eliminate risk of interruption to supply; there is a formally adopted statistical risk of interruption in every market which informs the generation capacity to be provided to meet forecast levels of demand. Ireland's reliability standard implies a level of risk which is higher than most European countries.

The pressure which increased demand from data centres would create for the electricity system, in particular for the grid, was anticipated. However, the importance of the sector for the digitalisation of the economy and for foreign direct investment in key sectors was highlighted by a Statement of Government Policy in 2018 which underlined the strategic importance of data centres in the context of planning and development. It was envisaged that a more plan-led approach to data centre development would reduce stress on the electricity system.

The annual Generation Capacity Statement (GCS) published by EirGrid and the System Operator for Northern Ireland (SONI), who operate the transmission system and whose insights into the market from their processing of applications and enquiries about connection to the grid provide the basis for their forecasts, had since 2016 highlighted tightening margins between supply and demand. The GCS forecast that by the mid-2020s there would be a significant capacity deficit which could materialise sooner if older plant became more unreliable or exited earlier than anticipated. The GCS is designed to inform the regulator - the Single Electricity Market Committee (SEMC) - in designing auctions to procure capacity, as well as informing market participants planning investment and commercial strategies. The expectation is that generation capacity will be developed to avert forecast deficits.

Technical progress in enabling electricity generation from renewables to achieve the target of 40% by 2020 gave confidence that the target of 70% by 2030 would be achieved. The essential but supplementary role of conventional generation would be secured through the capacity mechanism of the Single Electricity Market, with new lower carbon natural gas generators replacing the exiting plant. In time, it was envisaged that these new generators would be converted to hydrogen and other renewable gas options.

In the event, the unpredictable onset of Covid, with its restrictions on maintenance activity for existing plants, and the unexpected outage of significant modern generators in Power Plant B and Power Plant A combined to trigger a crisis in response to which temporary emergency generation capacity was sought. In the event, that crisis was averted by the timely return of the two generators and the temporary emergency capacity was not procured. However this was quickly followed by the termination of projects which had been awarded capacity at auction by the SEMC. The impact of this termination of capacity and the failure to secure required capacity at subsequent auctions gave rise to an emergency situation in response to which it has been necessary to procure 700 MW of temporary emergency generation capacity, as well as to implement a number of mitigating measures to balance supply and demand on the system.

It was clear that there would be risks in securing a successful transition of the electricity system in the required timeframe. The timelines for exit of significant generation plant were set and the prospects for a significant increases in demand were clear. It is my opinion that the risk of a capacity shortfall was underestimated. In part, this reflected the fact that there was no single ownership of the planning risk involved in the delivery of significant new plant. The problem of delays encountered by major infrastructure projects, including in the electricity system, due to planning and environmental consent issues was evident. They had been commented upon by the International Energy Agency in its 2019 review of Ireland which named planning delays as the principal challenge to delivery of policy for the sector. A second factor was underestimation of the difficulties in designing and implementing capacity

mechanisms to secure investment in generation capacity. There are particular challenges in procuring conventional generation in the context of high and increasing levels of generation from renewables, particularly wind and solar. The tight timescale militated against the learning in the market through an iterative process by which regulators and investors arrive at auction parameters which result in procurement of appropriate capacity.

It is beyond the scope of this review to determine what specifically led to the termination of capacity which had been awarded, whether the auction parameters were appropriate, or the steps that might have been taken to reduce the risk of the capacity shortfall which has emerged. These are, to a significant degree, technical questions regarding the design of the energy market and the capacity mechanism in particular. These issues are being addressed in the public consultation which the SEMC has conducted on foot of a detailed analysis of the operation of the capacity mechanism prepared by EY Consultants for the Commission for Regulation of Utilities.

It is a matter of speculation as to what might have been done had the risk to a successful transition in the electricity market been understood to be greater than it was. It is reasonable, however, to suggest that measures which were taken when the capacity shortfall became evident could have been put in place earlier. For example, having regard to the pressure of demand from data centres, the new conditions for their connection to the grid which were introduced in 2021 could have been put in place at the time of the Government Statement on the Role of Data Centres in 2018. Had the new conditions been implemented in 2018 they would have reflected the plan-led approach to the development of data centres envisaged in the Government Statement. By that time, however, a very large number of data centres had already been connected or had offers of connection, but the new conditions could have influenced plans for those already in prospect.

Similarly, the Government Statement on Security of Supply published in November 2021 could have been issued earlier, perhaps at the time of the Climate Action Plan 2019 which set out an ambitious target for renewables in electricity by 2030. A statement of national policy that clarified that the renewables target also required a high provision of natural gas-based conventional generation to underpin security of supply would have provided clarity to the market in advance of the key capacity auctions from which capacity was subsequently terminated.

I have seen nothing to suggest that any of the agencies or individuals concerned with the design and operation of the electricity market have been other than with diligent, responsible and professional in the performance of their duties. Proper standards of governance and communication have been observed. I also believe that the response to the emerging crisis has been swift and appropriate. However, I believe that there are issues regarding the architecture and framework for the electricity market which contributed to the underestimation of risk and which should be addressed to ensure successful completion of the electricity market transition. My terms of reference require me to identify learning which may be relevant to strengthening policy, capacity, governance and operational effectiveness, rather than technical issues of the design of the electricity system, and my recommendations are framed in that context.

There are grounds for confidence in the strategic direction of the electricity system:

- the target for very high levels of electricity generation from renewables provides assurance regarding security of primary energy supply and progress towards decarbonisation;
- the potential to achieve this target is clear from the abundance of wind energy resource, both onshore and offshore, and the potential for much greater supply from solar power;
- the technical capacity to cater for very high levels of renewables on the grid has been established, albeit with significant challenges of implementation;

- necessary support for continuity of supply will be enhanced, along with accommodation of very high levels of renewables, through increased interconnection with other markets;
- technological advances are enabling the pressure of peak demand to be ameliorated through better storage of energy generated from renewables, more flexible demand side installations, and incentives through scarcity pricing to shift consumption from peak periods with support from smart metering;
- policies to promote energy efficiency will temper the rate of increase in electricity demand.

In many respects the situation reflects the assessment of the position given by the International Energy Agency in its 2019 review: " having set the policy landscape and defined the expected outcomes, it is now opportune to shift attention to implementation and close monitoring of the progress made".

It would, however, be wrong to suggest that securing the successful transition of the electricity market will be straightforward or without risk. Having regard to the scale of what is involved, the timescale is just as challenging as that experienced in the period since 2018. The experience of the recent past demonstrates that it is critically important that risks are appropriately assessed and that the mobilisation of responding measures is comprehensive and swift. Nor is the transition possible without facing up to difficult trade offs. Achieving the desired level of sustainability and security in the supply of electricity may require accepting a higher level of cost for consumers than might otherwise be the case. Security of supply is not an absolute; excess capacity would represent a very significant cost to be borne by electricity consumers. Judgements will need to continue to be made regarding the amount of capacity to be procured at auction and the auction parameters which are most likely to procure them. Nor is an effective electricity market just about generation capacity; it requires the availability and successful operation of a reliable transmission and distribution system, as well as appropriate and effective system services which provide adequate storage and flexibilities on the demand side to reduce the need for investment in capacity. These are, in the first

instance, matters for the Regulator. The consultation process initiated by the SEMC and described earlier is an important initiative in building confidence in the capacity of the Regulator to design and operate the market mechanisms to secure the necessary outcomes.

The delivery of the necessary infrastructure is also critically important for achievement of the targets set for 2030. The development and strengthening of the transmission grid and distribution networks set out in the Roadmap published by EirGrid represents a major undertaking to be implemented across the country. The building and connection of offshore wind generation capacity on the scale envisaged is also a challenge of national significance. Conventional generation capacity will also require significant development work if the target of 2GW by 2030 is to be achieved. Finally, the planned interconnectors, including the North-South interconnector, also represent major infrastructure development. Given the strategic impact of planning delays on infrastructure projects the timely completion of this agenda must be considered to be subject to significant risk.

Infrastructural development to support the transition is not solely an issue for the supply side of the market. The installation of smart meters for domestic consumers is well advanced and requires to be completed. The promotion of widespread installation of solar capacity by domestic and commercial consumers, as well as by commercial suppliers, will also require organisational support so that the potential benefits to the electricity system are fully realised. Large energy users, including data centres, have significant potential to contribute to the sustainability of the electricity system and ameliorate the demands they place on the system through their support for renewables, including direct supply arrangements, and through the installation of electricity storage and flexibility features in the design of their operating systems. Investment in energy efficiency more generally is also a significant contribution to the stability of the electricity system.

Two significant pieces of analysis of strategic aspects of the electricity system are set to conclude in the near future:

- the review of the SEM capacity mechanism being carried out by the SEMC on foot of the report commissioned from EY Consultants on which public consultation has concluded;
- the review of energy security being carried out by the Department on the basis of a technical analysis from CEPA Consultants on which a public consultation has also concluded.

In addition, the results of a review of planning legislation under the direction of the Attorney General are likely to be relevant to addressing the planning risk outlined above.

It would be timely therefore to develop a clear statement of national policy regarding the future of the electricity market. This should take the form of a comprehensive Government Statement setting out the details of the planned transition to be completed by 2030; the milestones and other parameters of a successful transition; the roles, responsibilities and expected outcomes from all those with responsibility for delivery of the various elements of the programme; and a clear statement of the benefits that will be realised on completion of the transition. This cross-departmental, cross-agency approach could be driven at a strategic level through the mechanisms established under the National Energy Security Framework to reflect the importance and urgency of the issues and to engage local authorities, development agencies, the social partners and the wider community in this transformative national agenda. This would be designed to bring clarity to the implications for the wider community of what is required, but also to assist in the practical completion of projects through strategic community engagement, identification of suitable sites and the development of implementation capacity.

Leading and directing this mobilisation of national effort will place additional demands on the Department, which already has an extensive and challenging remit in respect of energy matters. There is a strong case for the Department to develop its technical capacity, both

internally and through external advisory resources, to analyse independently the operation and performance of the electricity system, to support robust engagement with those with statutory responsibilities in this area, and to contribute to the development of European energy policy at a time of significant change in the European energy market. Ireland's particular needs and priorities - especially the distinctive characteristic of high reliance on intermittent renewables with limited external interconnection - need to be fully reflected in the development of European regulation. As state aid approval of the SEM is due to be renewed over coming years, the European framework is of particular significance.

While the independence of the Regulator is a key requirement of European electricity regulation and is embodied in national legislation, the design and operation of the electricity market are major concerns for national policy, across all three dimensions of system performance: security, sustainability and cost. There is, therefore, an obligation on the Minister and the Department to ensure that the performance of the system is aligned with key objectives of national policy. While the independence of the Regulator has been fully respected in the course of the events reviewed in this report, the Regulator, and EirGrid as transmission system operator, have respected fully the authority of the Minister, have engaged fully under the corporate governance framework with the Department and have given an account of their actions and plans as requested. Furthermore, the relevant legislation enables the Minister, under certain limited conditions, to give general policy directions to the Regulator on matters that do not pertain to SEMC and on a basis that takes account of the obligation to comply with European energy requirements.

It is therefore entirely appropriate that the Department would engage with the Regulator, and the transmission system operator, to ensure that their performance is optimal from the perspective of national policy. It would be appropriate for the Department to develop its own view on issues such as the appropriateness of the reliability standard - the Loss of Load Expectation - operating in the market and the scope for out-of-market measures to secure a timely transition of the system. It will have the opportunity to consider the outcome of SEMC review of the CRM in developing its own perspective on the future design of the market. The

Department should also satisfy itself that the Regulator and the TSO have sufficient capacity to undertake at pace their critical responsibilities for the successful operation of the system. This proposed engagement would build on the established pattern of interaction which has seen the Department respond positively to requests from the Regulator for support in the context of the Programme of Actions which it introduced in response to the crisis.

The measures which are recommended above will apply in the context of the Single Electricity Market. The Department, engaging on a bilateral basis with the relevant authorities in the post -Brexit context, has confirmed the agreed basis for the operation of the SEM. As European energy policy develops and the national electricity transition proceeds, there will be a need to sustain that bilateral engagement. In particular, it will be necessary to keep under review the effectiveness of the mechanisms by which the SEM is operated to ensure that it meets the desired and mandated benefits of the SEM while supporting progress towards decarbonisation. In that context, the Department will need to keep under review the appropriateness of the legislative framework within which CRU and the SEMC operate.

The crisis in electricity supply triggered by the generation capacity shortfall described in this report are, to a degree, a consequence of ambition for the modernisation of the economy and the rapid transition to a more sustainable, lower carbon energy system. The risks entailed in the pace of transition were, in my opinion, underestimated. The appropriate learning from that experience need to be applied over the remainder of this decade if the transition to even more ambitious goals is to be achieved on a more secure basis.